# GLAT - Guide for Teachers

**Holenko Dlab, Martina; Hoić-Božić, Nataša**

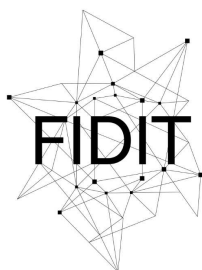**Educational content / Obrazovni sadržaj**

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# Games for Learning Algorithmic Thinking

## Guide for Teachers

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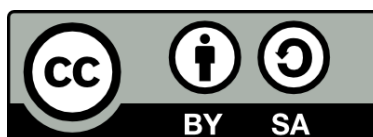
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# About this Manual

The aim of this manual is to guide teachers through the process of designing innovative learning experiences for the development of algorithmic thinking. It was created during the Erasmus+ project GLAT - Games for Learning Algorithmic Thinking which deals with encouraging the integration of algorithmic thinking into the daily teaching through different subjects in students' younger ages by using game based learning (GBL). The general indirect goal of the GLAT project is the development of algorithmic thinking of younger students and improving students' attitudes towards coding, which will in the long term contribute to reducing the "fear" towards coding and to increasing students' interest in the selection of future career in the ICT and STEM areas.

The first part of the manual brings lessons about topics related to algorithmic thinking and basic programming concepts as well as those about teaching and learning strategies that can be used for the development of algorithmic thinking and learning programming. Lessons include references to examples of outstanding learning activities and learning scenarios for various school subjects created during the GLAT project, which are included in the second part of the manual as annexes. In addition to examples of good practice, tools for preparing or conducting learning activities are suggested. For ease of reference, highlight sections of content that can be found in the manual are described in the remainder.

The most important information about the topic or definition of a key concept is highlighted at the beginning of each lesson.

Short examples of activities related to the topic that can be included in learning scenarios for different school subjects are given in the box *Classroom activities ideas*.

Each lesson contains one example of innovative use of approach described in the chapter, accompanied with pictures and links to digital resources.

*Toolbox* contains a set of useful digital tools related to the topic that can be used for preparing or conducting learning activities.

Click on the logo of a tool to open its home page.

Resources created during the GLAT project are highlighted in the box *GLAT resources* and available in the Part II: Annexes. Resources include *templates* (e.g. templates for designing learning scenarios, worksheets) and *examples of good practice.* Examples of good practice refer to resources (e.g. worksheets, games scenarios) and learning scenarios created by the participants of the project.

Click on the icon to open a particular resource in Part II.

References and web resources for further reading are listed at the end of each lesson.

# Contents:

# Part I:
# Lessons

# Introduction to Algorithmic Thinking

> Algorithmic thinking represents one of the concepts of computational thinking which is important for formulating problems. It represents a way of reaching a solution using a specific order of steps and it is appropriate not only for problems that are solved by computer but also for application in many other subjects and in everyday life.

An **algorithm** is a series of small steps that lead to the solution of the problem or task execution. These steps are instructions or rules that, if followed exactly (whether by a person or a computer), lead to solutions to the original as well as to similar problems.

In everyday life, an algorithm can be a cooking recipe, a multiplication of natural numbers, or a toothbrush procedure. Algorithms are used without being aware of it. In the digital world, algorithms provide the computer with a series of instructions that follow to complete the task.

"Brushing Teeth" algorithm:



Get a brush → Place paste on brush → Brush teeth → Rinse with water

## Computational thinking vs. algorithmic thinking

Computational thinking is a fundamental approach for developing programming and problem-solving skills. By using computational thinking skills, one can understand complex problems, develop possible solutions and present these solutions in a way that computers can understand them.

**Computational thinking** includes **algorithmic thinking** which is important for **formulating the problem**, previously analysed by logical thinking, evaluation, decomposition, abstraction, generalization and other computational thinking skills.

The basic **computational thinking** skills which can be developed since primary school are:

- **Decomposition** - Decomposition is used to break down a complex problem into smaller problems which are easier to understand. Then, one can solve them separately and integrate them in the final solution.
- **Pattern recognition** – During the process of problem solving, patterns (similarities among and within problems) can be recognized. Pattern recognition enables taking advantage of previous knowledge, achievements, or experience to reach a solution faster.
- **Abstraction** – Abstraction refers to focusing only on the important details and ignoring all irrelevant information. To apply abstraction, one needs to know how to choose details that can be ignored in order to make the problem easier, without neglecting the important information.
- **Algorithms** - When a similar problem needs to be solved, an algorithm can be designed using **algorithmic thinking**. By designing the algorithm, a specific sequence of steps or rules to solve the problem is specified and these steps can be reused whenever needed.

The algorithmic way of thinking is primarily developed by solving various problems that reflect real-life problems and situations where it is necessary to apply knowledge from other areas, especially natural sciences, mathematics and logic.

It is important that teachers encourage the integration of algorithmic thinking into daily teaching through different subjects from the first

to fourth grade of primary school. In that way, the students will be prepared not only for solving problems in other school subjects and in everyday life but also for later learning of coding.

Game Based Learning (GBL) for developing algorithmic thinking

Creativity, algorithmic thinking, and problem-solving skills must be encouraged already from the first grade of primary school in a fun and attractive way using games as a natural activity for children. Special focus should be on using educational strategies of Game Based Learning (GBL). Besides digital games on computers and mobile devices, the teacher can use unplugged activities for simulating algorithmic thinking through games and puzzles without the use of computer.
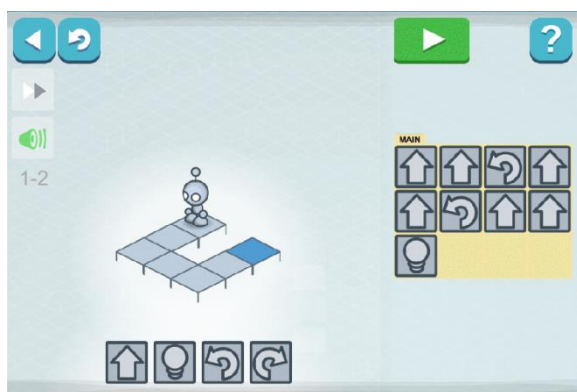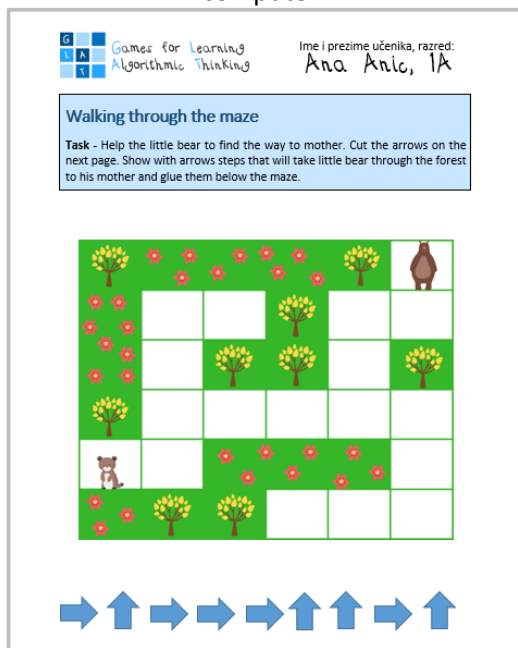




*Figure: Lightbot*

### Classroom Activities Ideas

During "Walking through the maze" unplugged activity students use the arrows on the worksheet to show the steps that will take the little bear to his mother.

In the "Human Robot" classroom game one player pretends to be a robot and the other gives instructions. The task is to instruct the robot to walk toward the door. There are 4 commands: walk forward, turn left, turn right, stop.

Students will learn some rhythmic and dance structures using an algorithm. The traditional dance is presented as an algorithm that uses sequences and loops.

Students play the digital game Lightbot that helps them think about how to

### Example

*Spatial orientation* – **unplugged activity for developing algorithmic thinking**

**Subject:** Science (1st grade)

**Learning outcomes:**

*General:*

- Determine the direction of movement left-right, up-down and back and forth
- Move in different directions in space (left-right, back and forth)
- Suggest the steps to navigate by default path
- Suggest the steps to move from starting to the endpoint

Focused on algorithmic thinking:

- Determine a set of commands to reach a predetermined goal
- Interpret the term algorithm

Aim, task and a short description of activities: As part of repetition and practicing the concepts: left and right, up and down, back and forth, the students will lead each other from the initial position to the final position in the classroom.

Teaching summary: for the motivation part, the teacher stands next to the door of the classroom and ask the students for help to get to the blackboard. The teacher can write his "path" on the blackboard stating the steps (commands) he has made. Other possible ways of getting from the door to the blackboard can be pointed out in the conversation with students, which brings a conclusion that the same task can be solved in several ways. The term algorithm is explained as a series of actions to be made in order to accomplish a particular task.

The **implementation** of activities includes team work in groups of four, where students lead each other in the maze made of desks and chairs in the classroom and write the algorithm of the movement.

As a **reflection** on the conducted activity students are required to provide examples of simple tasks they do every day (getting dressed, washing, preparing school bags ...) and create an algorithm for solving those tasks.

> **GLAT Resources**
>
> **EXAMPLE OF GOOD PRACTICE:**
> Learning scenario *Rhythmic and Dance structures*

BBC Bitesize, Introduction to computational thinking: https://www.bbc.com/bitesize/guides/zp92mp3/revision/1. (30.8.2019.)

Computer Science Fundamentals - Courses A-F, https://code.org/educate/curriculum/cs-fundamentals-international (22.8.2019.)

Project GLAT (Games for Learning Algorithmic Thinking): https://glat.uniri.hr/ (22.8.2019.)

Holenko Dlab, Martina; Hoić-Božić, Nataša; Anđelić, Matea; Botički, Ivica, Digital games and tools for development of computational thinking in primary school, Proceedings of the International Conference on Management, Economics & Social Science - ICMESS 2019, Brussels, Belgium, p.p. 1-7

# Introduction to Game Based Learning

> Game based learning (GBL) is a type of game play that has defined learning outcomes. The motivational psychology which is involved in GBL allows students to engage with educational materials in a playful and dynamic way. GBL is not just creating games for students but also designing learning activities which can introduce concepts and guide users towards an end goal.

In the past educational computer games were frequently based on the principles of the **behaviouristic theory,** where students got a question or a task and answered by choosing one of the offered answers. Based on their correct or incorrect answer they got a positive or negative response. Such games, point-and-click games or quizzes have drill and practice concepts and are suitable to learn basic arithmetic operations or to support memorisation of explicit knowledge.

**Cognitive theory** emphasizes student's activity and the formation of appropriate mental models. Students learn basic concepts from the learning activity and then they gain new knowledge with logical thinking. Games that are specific for the cognitivist approach are puzzles and strategy games.

**Constructivist theory** emphasizes that learning is an active process of constructing where students build new knowledge on their existing knowledge. Constructivist theory emphasizes discovery and inquiry learning, where students are placed in an environment and they construct their own new knowledge. Constructivist view of learning consists of three basic principles:

- Each student forms his own representation of knowledge,
- Learning occurs when students discover an inconsistency between their current knowledge representation and their experience,
- Learning takes place in a social context, interaction between learners and peers is an important part of the learning process.

Learning materials include instructions that support knowledge construction. A lot of computer games simulate various real-life scenarios in computer game format, where students inhabit a certain role. The role of a teacher is to give instructions and feedback when a student constructs his knowledge.

Whitton and Moseley proposed a framework for good practice in serious game design from an active learning perspective. The game environment should support active learning with exploration, problem-solving, have achievable goals, be appropriate for the learning context, provide equal opportunities for all, introduction of increasing complexity, be supported with some kind help or hints.

## Classroom Activities Ideas

Students learn to give instructions and sequence of commands for activities from everyday life (e.g. preparing a sandwich, learning to dance) in **digital games** or **unplugged activities**.

Students deepen their understanding about the fractions through playing **digital games**, solving **interactive worksheet** or **unplugged activities**.

By playing the **digital game** "Let's eat healthy!" students apply their knowledge about healthy food, names of the daily meals, and how to set the cutlery

## Game based learning

Educational games must be designed to facilitate some learning objectives. Learning with games is more time consuming than traditional learning so the use of games can only be justified if learning objectives cannot be efficiently achieved otherwise. Games are usually not a stand-alone activity but they are a part of learning process. Activities can be carried out before, during or after the game playing, or as a set of activities compose the whole learning process.

- Activities **before** playing the game: usually used as an introduction, where the teacher presents the rules, the goals, the context of the game or even learning goals which are hidden in the game. If the player can recognize the rules and the goals by himself, these activities can be left out.
- Activities **during** the gameplay are less frequent. Their role is to help the player if he has some problems during playing the game.
- Activities **after** playing the game are inevitable. Players must have an option to discuss with peers and the teacher, to provide reflections concerning their own experiences with the game. This discussion can include reflection on what they have experienced, learned, how they can use their new skills and new knowledge or what could be improved. The game can create a unique journey where players find their experience engaging, interactive and memorable.

Kolb's Learning Cycle says that for the learning process is vital the learner's opportunity to reflect on his own learning experiences. By encouraging learners to reflect on their activities they are exploring *why* they are doing it and not just *how* they are doing it. For effective learning the learner must progress through a cycle of four stages: 1) a concrete experience; 2) observation and reflection on that experience; 3) formation of abstract concepts and generalizations; 4) test hypothesis in future situations, resulting in new experiences. Learners are required to complete all the stages.

All the activities mentioned above are gathered in the so-called pedagogical package, which has to be prepared and offered to the teachers.

### Example

***Addition and subtraction up to 20 (repetition)*** *–* **Game based learning**

**Subject:** Mathematics (1st grade)

**Learning outcomes:**

*General:*

- Demonstrate the procedure of adding numbers to 20
- Demonstrate the procedure of subtracting numbers to 20
- Developing speed in addition and subtraction
- Compare and distinguish between correct and incorrect solutions

*Focused on algorithmic thinking:*

- Indicate the steps to move through the correct solutions
- Interpret the concept of an algorithm
- Describe and specify solutions to achieve a specific goal

**Short description:** Students repeat and practice the addition and subtraction up to 20 with playing a mathematical memory game, solve the worksheet and play bingo.

Students will get familiar with the concept of *algorithm* as a sequence of commands/rules that need to be executed to achieve the goals.

**Game elements:** Students participate in three activities. The first activity is a Math memory game where students should match a math expression with the correct result. In the second activity, they individually solve the worksheet – a maze. They need to calculate math expressions to help a boy to find the right way to the ice cream. In the last activity, students and teacher play bingo. Instead of numbers, the teacher reads-out random math expressions.

| CILJ | 19 | 3+16 | 3 | 17-14 | 17 | | | |
| | | 16 | | | 10+7 | | 18 | |
| | | 7+12 | 19 | 19-10 | 10 | 19-9 | 19 | 3+16 |
| 19 | | 7 | | | | 19 | | 3 |
| 7+11 | 8 | 16-9 | 16 | 6+10 | | 18+2 | 18 | 12-9 |
| 7 | | 16 | | 6 | | 18 | | 12 |
| 19-12 | 19 | 14+2 | | 18-12 | | 11+7 | 7 | 18-6 |
| | | 14 | | 18 | | 11 | | 18 |
| | 13 | 19-3 | 19 | 14+3 | 17 | 17-12 | 5 | 5+13 | 8 |
| | | | | START | | | | |

*Figure: Maze worksheet*

## GLAT Resources

**EXAMPLE OF GOOD PRACTICE:**
Games in GLAT Scratch studio

**EXAMPLE OF GOOD PRACTICE:**
Learning scenario *Addition and subtraction to 20*

**Resources and references**

Rugelj, J. (2019). Game design based learning of programming. Proceedings of SLET 2019 – International Scientific Conference «Innovative Approaches to the Application of Digital Technologies in Education and Research», Stavropol – Dombay, Russia, 20-24 May 2019.

What is GBL (Game-Based Learning)?: https://edtechreview.in/dictionary/298-what-is-game-based-learning (10. 7. 2019.)

Whitton, N., & Moseley, A. (2012) Using Games to Enhance Learning and Teaching: A Beginner's Guide. New York: Routledge.

Zapušek, M., Cerar, Š. & Rugelj, J. (2011). Serious Computer Games as Instructional Technology. Proc. MIPRO 2011 [Vol. 4], Computers in education, Rijeka: MIPRO, 93-95.

Videnovik, M., Madevska Bogdanova, A., Trajkovik, V. Serious Games Evaluation Methodology. Proceedings of ICERI2018 Conference, November 2018, Seville, Spain, pp. 1354, 1361

Hoić-Božić, N., Holenko Dlab, M., Načinović Prskalo, L., Rugelj, J., Nančovska Šerbec, I. Games for Learning Algorithmic Thinking – GLAT Project. International Journal of Multidisciplinary Research, Vol. 4 (2), 2018. pp. 73-95.

Educational games portal: http://hrast.pef.uni-lj.si/games/index.html (10.9.2019.)

# Learning Scenarios

Learning scenarios are materials intended for teachers that offer innovative and imaginative ideas for conducting teaching activities using modern pedagogical methods with the use of appropriate digital content and tools. Designing a learning scenario is a process by which teachers plan or structure a learning situation.

Teaching has always involved some elements of 'design' in the process of preparation and planning. Teachers have to plan the learning situations in advance. The situation may be as small as a single task or as large as a whole course.

The main elements that any learning scenario should have are the **description of activities**, **learning outcomes** that will be realized with described activities, **teaching methods and strategies** and digital **tools** for achieving the learning outcomes. A learning scenario can be prepared for one activity or a sequence of activities. The learning scenario can be written as a document in any text editor or design in graphical tool for creating a learning scenario such as LePlanner or Learning Designer. In any case, described activities and tasks should be designed to motivate students, to bring them closer to the content and to link the content of a teaching subject to everyday life situations.

## Classroom Activities Ideas

The teacher can plan activities that will help students to understand the value of the cultural sights of the coastal region. After **motivation**, Kahoot! quiz or a memory game can be used for students to adopt key concepts and define a problem issue. During **implementation**, via **problem based learning** students can explore the specifics of cultural sights (group work on a computer), present the collected information, and **repeat the learning unit** by solving an interactive

The Learning scenario template, designed for GLAT purpose has following components:

- The Learning Scenario Title
- Course/Grade
- Learning Outcomes
- Aim, Task and Short Description of Activities
- Keywords
- Correlation and Interdisciplinarity
- Duration of Activities
- Learning and Teaching Strategy and Methods
- Teaching Forms
- Tools
- Resources/materials for the Teacher
- Resources/materials for the Students
- Teaching Summary
  - Motivation-Introduction
  - Implementation
  - Reflection and Evaluation
- Annexes
- Examples and Game References

Although learning scenarios commonly use digital content and tools, they can be created for activities that do not use technology.

The teacher can start the process of creating a **learning scenario** by selecting a **topic** (teaching units), then define **learning outcomes**, and then structure one or more **activities** to fulfil the purpose of the learning situation.

SELECT THE TEACHING UNITS → DEFINE THE LEARNING OUTCOMES → DEVISE ACTIVITIES
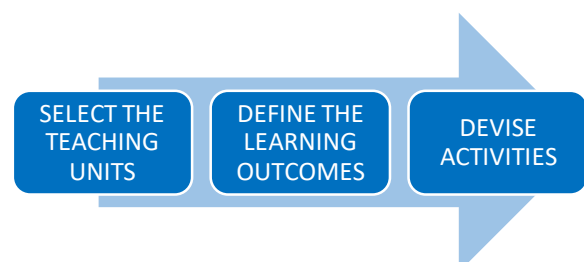
**Learning outcomes** should consist of the general outcomes of the subject and specific outcomes for encouraging algorithmic thinking.

The learning outcomes are typically expressed in the form *learners will be able to /verb/ /qualification/* where the verb describes the kind of an activity that learners will undertake (e.g. describe, interpret) and the qualification describes the context, scope or method to be used.

The **description of activities** is complemented with materials and resources for the teacher and students as well as **tools** for supplementing the selected teaching methods and fulfilling the learning outcomes. Activities can be individual or group, depending on the tasks and the age of students. Collaborative learning should be encouraged from an early age to help students acquire the habit of such work. Student activities should be aligned with the desired learning outcomes and with the processes of **assessment** and **review**. That is why the process of creating a learning scenario is cyclic:
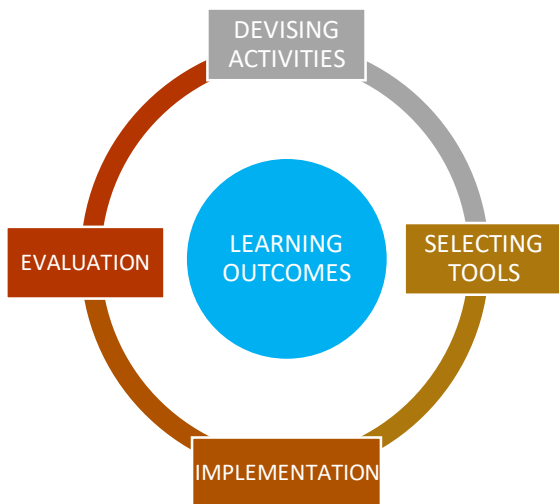


For primary school teachers the best way to fulfil the learning outcomes and tasks of active learning is to apply game based learning (GBL) and problem based learning (PBL) with introducing algorithmic thinking as concept of problem solving.



### Example

***Playing and revising about the traffic* – learning scenario**

The first part of the example of GLAT learning scenario is shown on the following picture:



**Learning Scenario**

**Workshop 1: GBL and unplugged activities**

| Learning Scenario Title | Playing and revising about the traffic |
|---|---|
| Course/Grade | Science<br>Homeroom class (topic "Personal and social development")<br>2nd grade of primary school |
| Learning Outcomes | *Learning outcomes focused on general subjects*<br>• Notice traffic signs for pedestrians<br>• Distinguish, name and compare bus station, train station, airport and shipping port<br>• Describe the importance of traffic connections in the homeland<br>• Name the professions related to the traffic and means of transport<br>• Connect knowledge about traffic signs, means of transport and behavior in traffic into a logical unit<br>• Apply knowledge in everyday life situations<br>• Review own traffic culture<br><br>*Learning outcomes focused on algorithmic thinking*<br>• Use the if command<br>• Find different, but the shortest solutions for achieving a certain goal (the shortest path in the game) |
| Aim, Tasks and Short Description of Activities | By playing the game according to the rules, students revise subject matter about traffic, means of transportation and traffic signs within the Science course. In the homeroom class, students learn about the decision concept, how to make a decision and about its consequences. In the game TRAFFIC, students will practice the application of the decision making model on examples by rolling a die, answering the questions, making decisions and accepting the responsibility.<br><br>- - - -<br><br>Students will use the if command to revise the subject matter, play the game according to the rules - answer all the questions and reach the goal as fast as possible. |
| Keywords | - means of transportation (train, bus, airplane and ship), traffic signs<br>- decision, consequence, choice<br>— — —<br>- algorithm, command, a condition for making the decision, if command |
| Correlation and Interdisciplinarity | Mathematics, Homeroom class, Informatics |

The **Teaching Summary** of the scenario *Playing and revising about the traffic* has three parts: motivation, implementation and evaluation.

For the **motivation,** teacher leads an introductory conversation with students about their way of arrival to and departure from school. The conversation includes questions like: Do they come on foot, by car, by bus? What traffic signs do they see on the road? Do they always use the same route? Is there another way to go to school? Is a particular route longer or shorter? Based on discussion about longer or shorter routes, students repeat the model of decision making and its consequences. For example: "If I use the long way I have to wake up early, otherwise, I can sleep longer."

Students give everyday life examples of the decision concept: if-then-else (If I get a good grade, then I can play games longer, else I have to study more.)

In the i**mplementation part** students are playing the own board game TRAFFIC and practice the application of the decision-making model on examples by rolling a die, answering the questions, making decisions and accepting the responsibility. The aim of the game is to reach the end of the path on the game board by stepping on as few fields as possible.

As **reflection** the teacher discusses the game with the students using the following questions: How did you like it? Do you have any new suggestions/ideas for the game? What were the consequences of your decisions? Would you make different decisions and why? Did everyone respect given rules? . . .

**Toolbox**

LePlanner

**GLAT Resources**

**TEMPLATE:** *GLAT learning scenario template*

**EXAMPLE OF GOOD PRACTICE:** Learning scenario *Playing and revising about the traffic*

Code Studio: https://code.org/curriculum/course1/6/Teacher (3.7.2019.)

Hour of Code (Template Lesson Plan): https://hourofcode.com/files/EducatorHourofCodeLessonPlanOutline.docx (3.7.2019.)

Colaborative Education Lab: http://colab.eun.org/learning-scenarios (3.7.2019.)

CARNet Learning scenario: https://scenariji-poucavanja.e-skole.hr/ (3.7.2019.)

Learning Designer: https://www.ucl.ac.uk/learning-designer/ (3.7.2019.)

Mezak, J., & Papak, P. P. (2018, May). Learning scenarios and encouraging algorithmic thinking. In 2018 41st International Convention on Information and Communication Technology, Electronics and Microelectronics (MIPRO) (pp. 0760-0765). IEEE. https://ieeexplore.ieee.org/abstract/document/8400141 (3.7.2019.)

Quaicoe, J. S.; Laanpere, M.; Pata, K.; Hoić-Božić, N.; Rõbshenkov, R. (2019). Games for Learning Algorithmic Thinking (GLAT) Project: Perceived Factors in Accounting for Teacher Acceptance and Usage of a New Learning Scenario Design Tool - The LePlanner. EDULEARN19 Proceedings: EDULEARN19, The 11th Annual International Conference on Education and New Learning Technologies, Palma de Mallorca (Spain). Ed. Gómez Chova, L; López Martínez, A; Candel Torres, I. Palma de Mallorca (Spain): IATED Academy, pp. 7898-7906.

# The LePlanner

The LePlanner is an online application that simplifies the preparation and facilitation of teaching and learning activities. It offers opportunities for designing and visualizing learning scenarios, promoting co-authorship between teacher and students, and creating repositories of teaching and learning materials.

LePlanner was developed at the School of Digital Technologies at Tallinn University with the aim to enable the development of social networking learning spaces, sharing knowledge, and archiving teaching and learning resources.

Using LePlanner, teachers can design and visualize **learning scenarios**. Description of learning activities and resources for teachers and students are shown on the timeline. In their learning scenarios, teachers can design blended lessons and combine activities that will be done *in class* and which are to be done *out of the class*.
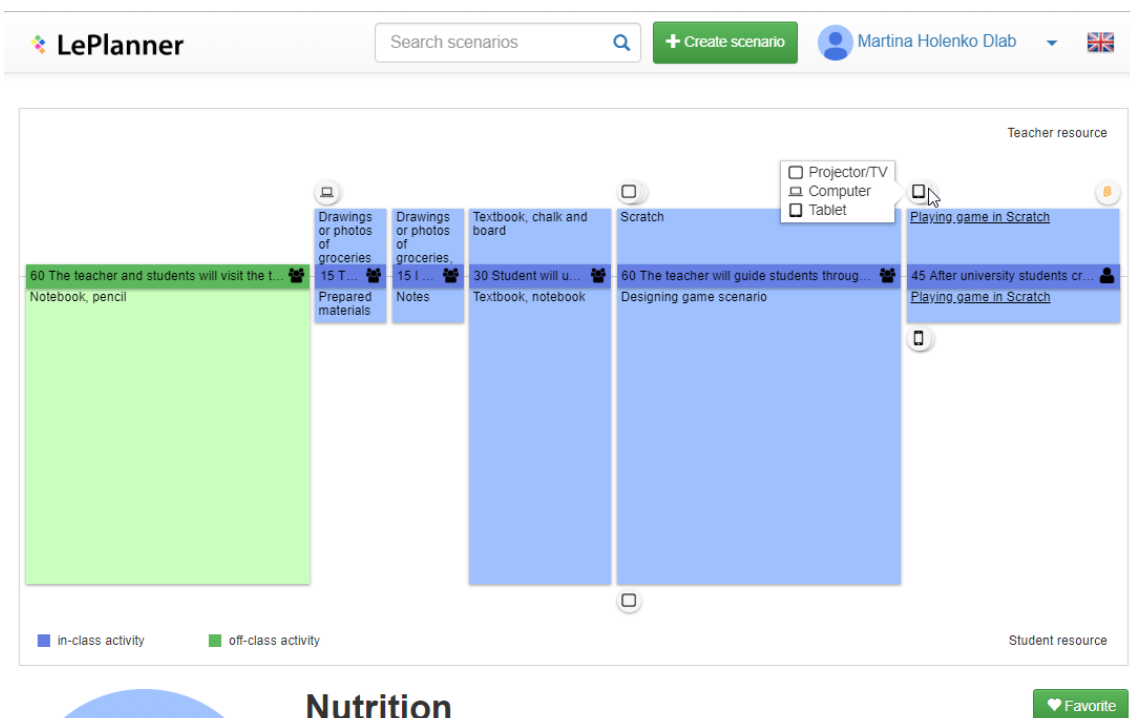
All users have their designed lesson scenarios archived and other users of the platform could search and reuse these resources.

The tool is currently available in three languages: Estonian, English, and Croatian.

## Designing and visualizing learning scenarios

When designing the learning scenario with LePlanner, the teacher needs to define the following *details*: title, description, subject to be studied, grade, and duration. Details also include expected learning outcomes and a list of planned learning activities. Activities for students can be individual or collaborative (in pairs, in small groups or class-based), performed in-school or off-school. Assessments and feedback channels can be included in the scenario. The scenario can be tagged (tags can be used in search queries).
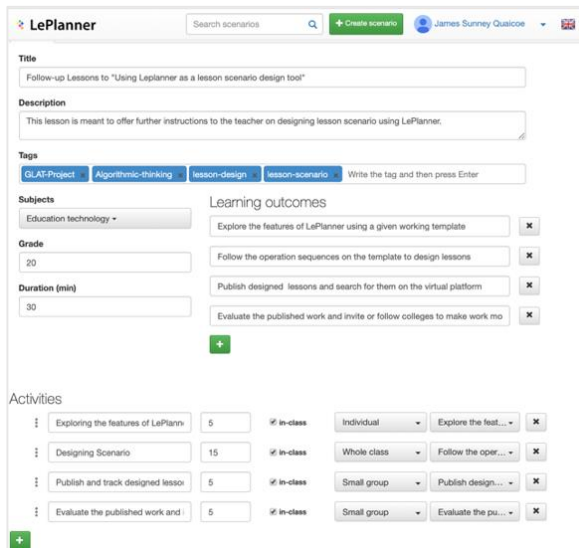
The *timeline* gives a visual representation of the designed lesson plan. Under this option, teacher's and student's resources are defined together with the related resources and technology that will be used in planned activities.

*Figure: Details of learning scenario*

Under the *publish* section the lesson plan is saved as a draft or made public. In addition, the language used is indicated (language can be used in search queries).

 Example

***Seasons* - Visual representation of the learning scenario**

**Link:** Learning scenario in LePlanner

**Subject:** Science (2nd grade)

**Learning outcomes:**

*General:*

- Recognize the characteristics of seasons
- Explore the specifics of the seasons and seasonal fruits
- Associate appropriate clothes with specific seasons
- Identify and name seasonal fruits
- Compare and classify seasons and fruits

*Focused on algorithmic thinking:*

- Search, find, and extract relevant information
- Summarize and extract elements by attributes
- Identify and apply basic programming concepts when designing a game in Scratch

 Classroom Activities Ideas

The teacher plans activities for the students to practice the multiplication table by combining individual activities where students play games using tablets with unplugged activities for the whole class.

The teacher plans a group project about seasonal fruits. After in-class activity for motivation, students perform individual off-class learning activity for gathering information about seasonal fruits specific to their region. Students then participate in a collaborative in-class activity where they create posters. Each group creates a poster for one season. The learning scenario ends with activity for reflection on the project.

**Activities:**

**Activity 1:** Motivation (whole class, in-class)

The students play a game of association. Then they
watch an animated video "Four Seasons" on YouTube and comment it. The teacher introduces them to the problem when people need to leave their homes and go with their families to other parts of the world because the soil has dried up and vegetables and fruits cannot be grown.

**Activity 2:** Instructions for research assignment (small groups, off-class)

The teacher divides students to small and each group needs to solve a specific part of a project assignment (characteristics and seasonal fruits for one of the four seasons). Students need to explore the specificities of seasons and seasonal fruits at home, with the supervision of the family members.

**Activity 3:** Creating posters (small groups, in-class)

Each group makes their own poster with the theme of the given season and its seasonal fruits that they have explored.

**Activity 4:** Presentations (pairs, in-class)

Two students from each group briefly present the poster. They mention the main season's characteristics and list seasonal fruits.

**Activity 5:** Designing the story/game (whole class, in-class)

The students, with the help of the teacher, design the story/game about a girl who came from Africa and wants to learn about the seasons.

**Activity 6:** Reflection and evaluation (individual, in-class)

The students play the game they have designed and give opinions on the activities carried out by marking smiley faces on the board (they wrap wool/thread around the pins near the smiley faces).

## GLAT Resources

**INSTRUCTIONS:** *LePlanner Instructional Sheet*

**EXAMPLE OF GOOD PRACTICE:** Learning scenario in LePlanner *Seasons*

**EXAMPLE OF GOOD PRACTICE:** Learning scenario in LePlanner *Nutrition*

**EXAMPLE OF GOOD PRACTICE:** Learning scenario *Nutrition*

LePlanner Tutorial: https://vimeo.com/168032150 (30.8.2019.)

Repository of already prepared lessons on LePlanner: https://beta.leplanner.net/#/ (30.8.2019.)

Quaicoe, J. S., Laanpere, M., Pata, K., Hoić-Božić, N. Games for Learning Algorithmic Thinking (GLAT) Project: The influence of personal and environmental factors on perceived usefulness and usage of the LePlanner - learning scenario design tool. Proceedings of the Conference of the International Council of Educational Media (ICEM), 2018, Tallinn, Estonia

Quaicoe, J. S., Laanpere, M., Pata, K., Hoić-Božić, N., Rõbshenkov, R. Games for Learning Algorithmic Thinking (GLAT) Project: Perceived Factors in Accounting for Teacher Acceptance and Usage of a New Learning Scenario Design Tool - The LePlanner. Proceedings of the 11th Annual International Conference on Education and New Learning Technologies - EDULEARN19, 2019, Palma, Spain, pp. 7898-7906.

# Unplugged Activities

Unplugged activities for development of algorithmic thinking are activities in which students do not use digital devices but physical objects (e.g. board games, cards, strings) or movements (e.g. footsteps, dance) to represent and understand concepts. The unplugged approach is convenient for classrooms without the technology infrastructure. For preparation of materials for unplugged activities (e.g. cards, worksheets), Web 2.0 tools can be used.

Using unplugged activities, algorithmic thinking can be developed in various school subjects and in cross-curricular topics. The tasks based on unplugged activities suitable for primary school students can be classified in the groups described below.

**Finding words in the grid** – Students need to find words and describe their position with arrows.

**Real-life algorithms** – Students recognize algorithms in their daily lives and describe them using a set of images.

**Algorithms and analogies for concepts related to specific school subjects** – Students write rules to perform mathematical operations, grammar rules, or a song as algorithm.

**Moving through a maze** – Students need to plan a route from the start location to finish and use arrows to describe the path. To make it more fun to the students, animals, favourite characters from movies or comics, etc. can be included in the maze.
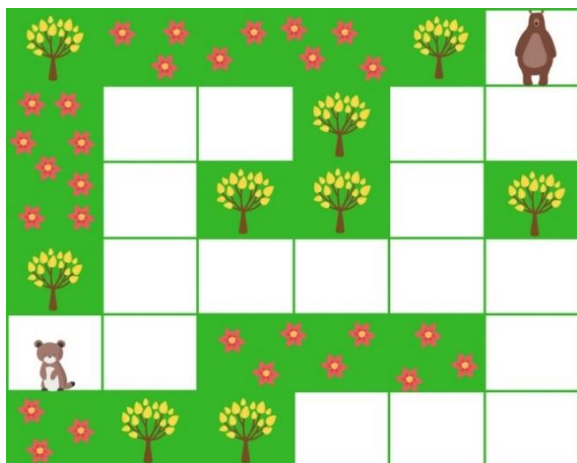


**Tales and algorithms** – Students should recognize algorithms in familiar stories and fairy tales. For example, Elisa knits shirts for her eleven brothers in *The Wild Swans* tale by Hans Christian Andersen; Hansel and Gretel execute an algorithm to get home from the forest; a prince is looking for a girl whose foot will fit the shoe in *Cinderella*.

**Writing or drawing in a grid** – Using a sequence of signs students draw shapes or write numbers and words in a grid.

Mentioned tasks can be used in different parts of the lesson and are suitable for individual and collaborative work.

## Classrom Activities Ideas

The class is divided in groups. Each group obtain all parts of algorithm and must **order them in a proper way**. The winner is the group that ordered algorithm first.

Students perform a **dance or gymnastic exercise** according to a given algorithm, described with a set of pictures.

Students write an algorithm using a set of predefined commands to direct their classmates to **reproduce a drawing** (to colour squares on graph paper).

Students are divided in two groups. The first group has to hide words in the grids and describe with arrows how to find the words. Second group has to follow the algorithm for moving to **find the words**.

**Using Web 2.0 tools for preparing materials for unplugged activities**

Web 2.0 tools are applications available on the Web that replace desktop applications and allow users to create and exchange multimedia content and ideas through social networking. These tools help educators to enhance their teaching practice in a creative manner.

To prepare resources for unplugged activities teachers can combine word-processing software (e.g. Google Documents, Microsoft Word, etc.), and Web 2.0 tools for creating graphics, especially those that offer ready-made graphical elements free to use.

An example of a Web 2.0 tool useful for preparation of graphical resources is Canva (https://www.canva.com). The basic version of Canva is free and teachers could register account with e-mail or could use existing account in Facebook or Google. Teachers can use predefined templates, insert of ready-made graphical elements (images, icons, wallpapers), insert text, insert own files, and save and export files.

 Example

*Walking through the maze* - **Worksheet**

For unplugged activity ***Walking through the maze***, presented in the *lesson Introduction to Algorithmic Thinking*, a worksheet can be prepared using chosen word processing software and Canva. A task and a maze should are placed on the first page of the worksheet. The second page contain arrows that students should cut and glue below the maze.



**Toolbox**

Word processing software:



Graphics editors:
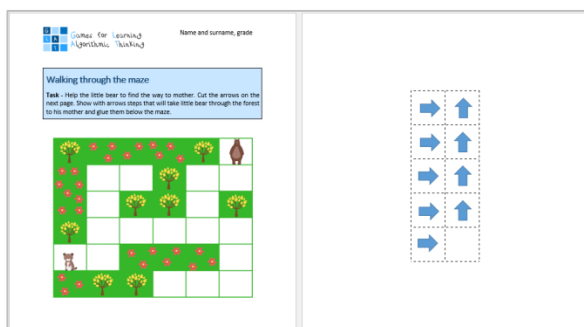


The first step is to prepare a document that contains the task and the table with arrows. Then, a maze could be designed in Canva using the following steps:

1. Create design > Custom dimensions (e.g 15x15 cm)
2. Use the option **Background** to choose green colour for the background.
3. Use the option **Elements > Grid** to create grid with 6x6 cells (choose among predefined grids).
4. Click in each cell of the grid and colour it in green or white using the tool **Color** (choose among offered colours).
5. Use the option **Elements** to search for images of bears, tree and flowers. Drag and drop selected images to the appropriate place in the grid. If necessary, resize images.

The image of the maze should be exported as a .jpg file and imported in the worksheet document.

Another way to prepare a maze is to use word processing software to insert and format table with 6x6 cells and insert previously prepared images of trees, flowers and bears.

The result expected from students is:





GLAT Resources

TEMPLATE: *Worksheet template*

EXAMPLE OF GOOD PRACTICE:
Worksheet *„Crikvenički tanac" dance*

EXAMPLE OF GOOD PRACTICE:
Worksheet *Moving through the maze*

EXAMPLE OF GOOD PRACTICE:
Learning scenario *Moving through the maze/Spatial orientation*

CS Unplugged Activities, https://classic.csunplugged.org/about/ (7.6.2019.)

CS Fundamentals Unplugged, https://code.org/curriculum/unplugged  (7.6.2019.)

6 Unplugged Coding Activities for Hour of Code, http://info.thinkfun.com/stem-education/6-unplugged-coding-activities-for-hour-of-code  (7.6.2019.)

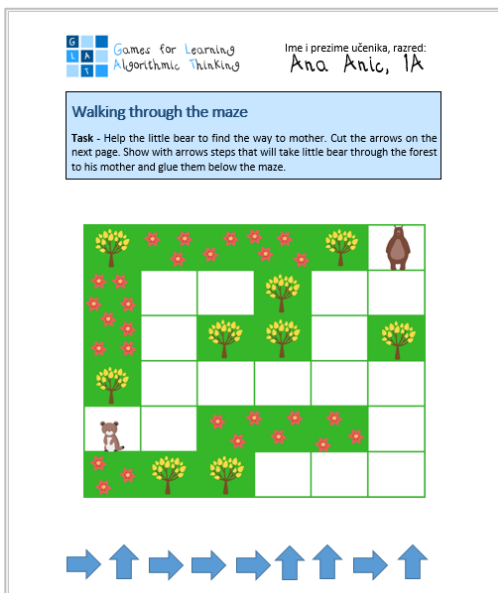Tim Bell, Ian H. Witten, Mike Fellows, Computer Science Unplugged... off-line activities and games for all ages, http://www1.idc.ac.il/csu/CSU%20book/unplugged%20book%20part1.pdf  (7.6.2019.)

Technology unplugged activities, https://www.erintegration.com/2017/05/16/technology-unplugged-activities/ (7.6.2019.)

Coding Unplugged, https://teachyourkidscode.com/category/coding-unplugged/ (7.6.2019.)

Canva - Teacher resources, https://www.canva.com/learn/teacher-resources/ (7.6.2019.)

Tuparova D., Teaching of computer programming in Bulgarian primary school – challenges and solutions, International conference MIPRO, 2019, Opatija, Croatia.

Tuparova D., Possibilities for development of algorithmic thinking through game based learning and unplugged activities in primary school, 15th Annual Conference on Computer Science and Education in Computer Science - CSECS, 2019, Fulda, Germany.

# Introduction to Problem Based Learning

📝 Problem Based Learning (PBL) is a pedagogical strategy that uses a real-life problem to trigger learners' engagement in collaborative learning and to improve their strategies of critical thinking, information seeking, and knowledge sharing.

## Principles of Problem Based Learning

It is worth noting that Problem Based Learning is defined by the following principles:

1. Student-centered and self-directed, rather than teacher-led or teacher-centered engagements.
2. It is characterized by engaging in collaborative activities and an individual problem-solving pursuit.
3. It is intended to be iterative, not linear (regarding the learning process structure).
4. It is more of an active process, not a passive one (regarding learners' role).
5. It is reflective and not silent observation or engagement.
6. It should be conducted for developing and improving the subject knowledge, and not just for engaging in the venture (just for fun).

PBL is similar to:

- **Inquiry based learning** which is knowledge discovery through active experimentation and hypothesis-testing; not "acquired from textbook"
- **Project based learning** that has to do with hands-on collaboration towards the production of a deliverable
- **Case based learning** which is associated with solving tasks related to a real-life case or situation
- **Active learning** where students are actively engaged in knowledge building
- **Experiential learning** which is characterized by planning, enacting the plan, reflection on action, and providing theory-inspired explanation.

Problem Based Learning is sometimes misunderstood:
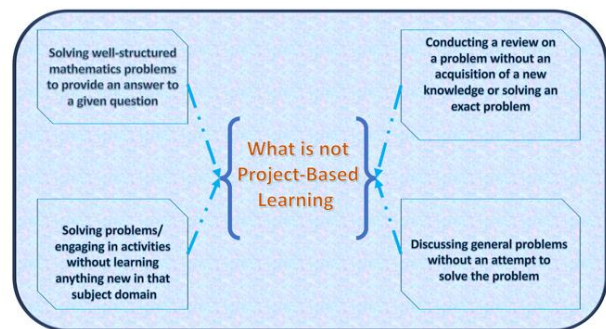


## Sequence of operation for conducting PBL

Suggested operational sequence for conducting PBL lessons in the classroom:

1. Set the stage for the lessons, by defining the **purpose** and **procedure** students are to follow.
2. Create the environment for student based brainstorming activities.
3. Facilitate a student-driven **problem definition** session(s).
4. Create the settings for research, generation of ideas, formulating suggested solutions and documentation of activities.
5. Enhance the collaboration among students, but do not (teacher) provide answers or information leading to the solution of the problem.
6. Conduct formative assessment to avoid situations of student digression.
7. Create a medium for class discussion, feedback or dissemination.
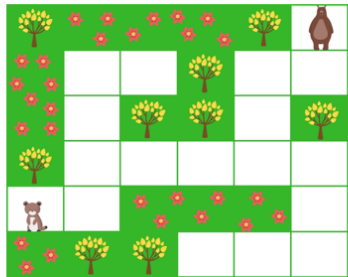8. Assess whether the solution is genuine.

## Games for Learning Algorithmic Thinking

### Classroom Activities Ideas

For understanding a water cycle in nature, students in small groups conduct an experiment with heating and cooling water.

To illustrate the phenomena of elastic force and friction, students in small groups compile and program a robot.

For understanding a problem of renewable energy, students build a model of a wind generator using available resources.

### GLAT Resources

**EXAMPLE OF GOOD PRACTICE:**
*Learning scenario Months of the year*

**EXAMPLE OF GOOD PRACTICE:**
Match the Memory game *Months of the year*

### Example

***Months of the year (repetition)* – problem based learning activity**

**Subject:** Science (2nd grade)

**Learning outcomes:**

*General learning outcomes*:

- Name months of the year
- Determine the order of months of the year
- Explore the specific characteristics of each month of the year

*Focused on algorithmic thinking:*

- Distinguish elements by attributes
- Search, find and connect the month with its characteristics
- Compare and classify months of the year

For revising and systematizing the knowledge about the months of the year students play Kahoot! quiz and Match the memory game.

Students in groups are searching the web for one picture that represents the main characteristics of the chosen month of the year. After selecting the picture, the group elaborate to the rest of the class why exactly this picture presents the main characteristics of that month.

Each student makes a paper candle and writing on it a date of his/her birthday. They attach their candles to a picture of a large 12-layer cake. Layers are named according to the months of the year.

Resources and references:

Graham Clayton & Peter Pierpoint (1996) A brief introduction to problem-based learning https://www2.uwe.ac.uk/faculties/BBS/BUS/Research/NTFS/problem.pdf (29.8.2019.)

An introduction to Problem-Based Learning http://www.swlauriersb.qc.ca/english/edservices/pedresources/workshops/prosits/An%20Introduction%20to%20Problem-based%20Learning.pdf (29.8.2019.)

Barrett, Terry (2017) A New Model of Problem-based learning: Inspiring Concepts, Practice Strategies and Case Studies from Higher Education. Maynooth: AISHE http://www.aishe.org/wp-content/uploads/2017/05/Full-Book-A-New-Model-Of-Problem-Based-Learning-Terry-Barrett_book.pdf (29.8.2019.)

Jurković, V. Ed. (2005) Guide to Problem-Based Learning. Ljubljana: Slovene Association of LSP Teachers. http://www.sdutsj.edus.si/SDUTSJ_Guide_%20to_%20PBL.pdf (29.8.2019.)

Mezak, J., & Pejic Papak, P. (2019). Problem Based Learning for Primary School Junior Grade Students Using Digital Tools. In 2019 42nd International Convention on Information and Communication Technology, Electronics and Microelectronics (MIPRO) (pp. 697-702). IEEE. https://glat.uniri.hr/wp-content/uploads/2019/05/Mezak_Pejic_Papak_MIPRO_2019.pdf (29.8.2019.)

Tutorials on Problem-Based Learning: https://www.youtube.com/watch?v=XbH7-Qa9xaU (29.8.2019.)

# Online Quizzes and Logical Tasks

Logical tasks are related with correct reasoning and require human been to extract information; compare objects, subjects or activities; make conclusions, judgement, evaluation. On-line quizzes are tests of knowledge and skills performed online. They could be standalone (static), web 2.0 based or part of a Learning Management System.

Logical tasks could be part of different teaching and learning activities. They are suitable for mastering knowledge, assessment and evaluation in the teaching process, homework, teaching assignments or repetition tasks in various subjects. Logical tasks provide motivation, fun and interactive environment for problem solving.

The appropriate logical tasks for the development of algorithmic thinking are tasks for:

- Searching, finding and sifting essential from non-essential information
- Summarizing and excluding items by attribute
- Observing rules or establishing relationships
- Comparing and classifying
- Making conclusions.

To be performed in Web 2.0 environment logical tasks have to be transformed according to supported type of questions, e.g.: multiple choice, matching, fill in the gap, order, time line, etc... Multimedia elements of the tasks have to be prepared as well.

## Classrom Activities Ideas

The lesson could start with an online quiz or game to remind of concepts that will be need for the new lesson. An online quiz could be used at the end of the lesson. The aim is to check how students accept and understand the new material.

### Example of task for comparison and classification:

Earth, Jupiter and Mars are planets from the Solar System. Jupiter is larger than Earth, and Mars is smaller than Earth. Arrange the planets by size, starting with the smallest.
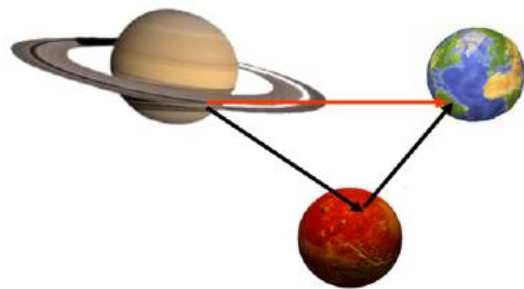


**Web 2.0 tools for online quizzes**

Many web 2.0 tools could be found on the web for the development and implementation of on-line quizzes.

The tools support different type of questions and multimedia objects. All of them have at least two types of users: teacher and student.

The main functionalities of the teacher's account include: the creation of quizzes, observing students' results. Also, some web 2.0 tools provide additional functionalities like class management, creation of students' accounts, set quiz as homework, obtaining statistics for students' achievements, sharing of quizzes with other teachers, etc. The main functionality of the student's account is test performance. As additional functionality of tools could be mentioned automatic feedback, leader board.

**Kahoot!** is a Web 2.0 tool where teachers can develop quizzes in a gamified fun manner. The teacher needs an account to create and manage games and class.

During the game the teacher presents questions with the use of a multimedia projector. Every item is shown for a limited time.

To play game in Kahoot! users need any digital device that supports HTML5. The students can use smart phones to give their answers. Students need only a PIN code to access game on the site kahoot.it. When students access the game they have to register only with their Nick name.

At the students' device they can see only shapes with possible answers.

When all students answer to the question, the teacher can see the temporary leader board with points of the first three players.

After finishing of the whole game students fill in questionnaires about their fillings during the game and the teacher can show final results of the game and can obtain statistics about achievements of the students and results from the questionnaire.

**LearningApps** supports a huge set of different type of learning applications (Apps) - quizzes, test questions and templates for interactive It is possible to create and play App without a user account, but to keep created App and manage class it is more convenient to register a teacher account.The teacher can select an app from already developed by another member of the

LearningApps community. The apps are classified by subjects and school levels.

The teacher can take the link to the app or SCORM package, iBook Author, or QR Code for access to the app and import them in the learning management system, social networks or any web site.

The teacher can create 8 types of quizzes and 11 types of games.

For every App exist three examples that could be used as a template and could be changed. A new App could be created as well. For every type of Apps, different multimedia elements could be used. The teacher can manage his or her own Apps and tools and organise them in folders.
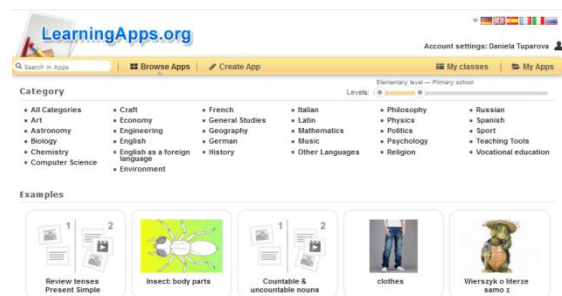


**Wizer** enables the development of interactive worksheets. The teacher has to register. Students do not necessarily need an account. They can access the worksheets through a PIN code. The tasks could be solved in class or at home.
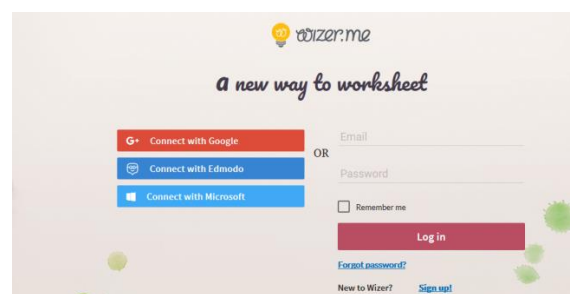


The interactive worksheets can include open type questions, multiple choices, fill in gaps in the text, filling in images, pairing, tables, sorting, drawing and discussion (discussion) can be used. Tasks can contain text, images, video and external links. Also the number of points can be determined for each task.

## Example

*Counting* - developed by a teacher who participated in the GLAT project:
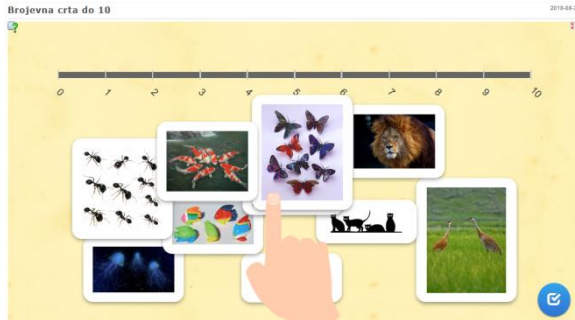


*Order algorithm* – App is developed by a member of the Learningapps community. The app could be used to check skills to construct algorithm.
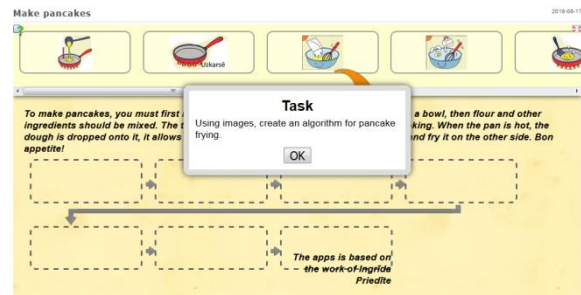


## GLAT Resources

**EXAMPLE OF GOOD PRACTICE:**
GLAT resources - LearningApps.org
(login: Glat1, glat)

**EXAMPLE OF GOOD PRACTICE:**
Learning scenario *Addition to 5*

### Resources and references

CARNet e-laboratorij: http://e-laboratorij.carnet.hr/category/interaktivni-sadrzaji/ (1.8.2019.)

Bebras challenges: https://challenge.bebras.uk/index.php?action=user_competitions (1.8.2019.)

Igrica: http://igrica.com.hr/ (1.8.2019.)

Mezak, J., Pejić-Papak, P., Problem Based Learning for Primary School Junior Grade Students Using Digital Tools // Proceedings of the 42th International Convention MIPRO 2019, pp. 805-810.

Tuparova, D., Teaching of computer programming in Bulgarian primary school – challenges and solutions // Proceedings of the 42th International Convention MIPRO 2019, pp. 836-840.

# Problem Solving

Problem-solving is the ability to identify and solve problems by systematically applying appropriate skills. Problem solving skills lead toward developing algorithmic thinking. It is part of everyday life because, both in learning and at work we continually make and execute algorithms, design series of activities and information flow processes.

We meet problems in our everyday life. Some problems that students have (both younger and older):

- How to travel from home to school
- How much money is needed to buy food and/or a treat
- Thinking about how the allowance will last till the end of a week
- Developing a strategy to reach the next level of a computer game
- Debugging a computer program.

If we possess the ability for problem solving, we are developing skills in employing science processes, but also in non-science subjects and daily life. The results obtained in solving tasks become a motivation for using the science procedure in the future. Problem solving develops **higher** thinking skills, responsibility, creativity, resourcefulness, critical thinking in the students. The students learn to accept opinions and evidence shared by others.

Problem Solving involves **both analytical and creative skills.** The following skills are key to problem solving:

- Analytical ability
- Creative thinking
- Initiative
- Logical reasoning
- Persistence.

A problem can be solved using a **five-step model** that most students can easily memorize and put into action. The model has direct applications to many areas of the curriculum as well as everyday life.

The model is described as follows:

1. *Understand the problem*

It is important that students understand the nature of a problem and its related consequences. Students should be encouraged to frame a problem in their own words. Spreadsheets can help.

2. *Analyze the problem*

Describe any barriers (obstacles). In short, what is creating the problem? Students should be encouraged to verbalize these obstacles, which is always an important step.

3. *Identify various solutions*

There are **many** strategies and no single strategy will work for all problems. Some problem-solving possibilities are: create visual images, create a table, work backward, create a systematic list, and look for a pattern.

By moving objects around on a table or desk, students can develop patterns and organize elements of a problem into recognizable and visually satisfying components.

4. *Try out a solution*

When working through a strategy or combination of strategies, it will be important for the students to keep accurate and up-to-date records of their thoughts, proceedings, and procedures. Try to work through a selected strategy or combination of strategies until it becomes evident that it's not working, so it needs to be modified.

*5. Evaluate the results*

Students should SELF-measure their problem solving skills. The teacher can ask students questions such as:

- "How do you feel about your progress so far?"
- "Are you satisfied with the results you obtained?"
- "Why do you believe this is an appropriate response to the problem?"
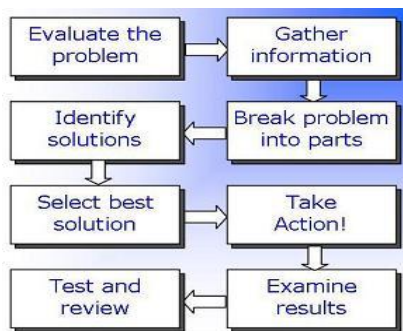


## Creative thinking and team work

In other situations, using creativity thinking will be necessary to come up with ideas for resolving the problem and find fresh approaches. Not everyone has these two types of skills in equal measure. For this reason, team working is often a key component in problem-solving.

The students learn to accept opinions and evidence shared by others, because it is unlikely that any individual will have all the knowledge or resources to make an effective decision. Groups provide a greater diversity of perspectives and the opportunity to test ideas before one is selected and implemented.



Figure: Problem Solving Skills A Brief Overview by Phil Bagge http://code-it.co.uk/attitudes/

## Developing the problem-solving skills

Most problem-solving skills are developed through everyday life and experience by utilizing 'Mind games' such as cryptic crosswords, Sudoku, chess, bridge, etc. Computer games – the chosen ones, can involve strategic planning critical and statistical analysis assessing the pros and cons of different courses of action.

### Classroom Activities Ideas

Students can use the 5-stage problem solving approach in solving mathematical problems by guessing the answer and then checking if the guess fits the conditions of the problem.

The teacher requires the students to solve the problem of choosing a means of transport to go on a school trip. The teacher prepares a list of offered solutions and students to use the elimination strategy to find an appropriate solution.

## Utilizing technologies

The IC technologies can also provide access to a vast array of information, including digital libraries, data for analysis, tools for organizing ideas (concept maps), presenting ideas (PowerPoint presentations).

Digitalization helps to develop problem solving skills even in students of elementary school by using fun educational games in the classroom.

### Example

*Find the right bracelet* – **Problem solving task**
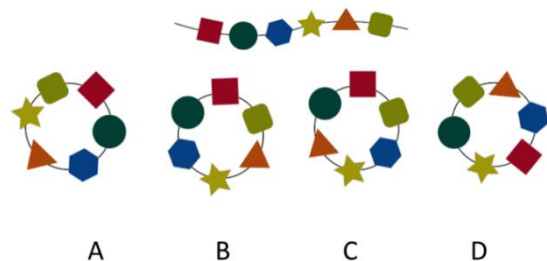
We are going to follow the five-step model described earlier.

1.  *Understand the problem*

How would you describe the problem?

We should find the bracelet that connects the ends of the string and fits the other parts.

2.  *Analyze the problem*

The data: there are 6 different shapes;

The conditions: the ends of the string must be next to each other in the bracelet. The shapes need to be in the same order in the bracelet;

Obstacles: the order is in only one direction.

3.  *Identify various solutions*

The possible solutions are offered (A, B, C, D)

▪   See if the solution meets the conditions and avoids the obstacles
▪   Or students can draw their idea of a solution and then compare to the offered ones

4.  *Try out a solution*

▪   Eliminate the ones that do not meet the first condition: the ends of the string must be next to each other: **eliminate D**
▪   Eliminate the ones that do not meet the second condition: the shapes need to be in the same order in the bracelet: **eliminate A and C**.

5.  *Evaluate the results*

The answer is **B,** following the process of elimination**.**

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**GLAT Resources**

**EXAMPLE OF GOOD PRACTICE:**
Match the memory game *Staple*

**EXAMPLE OF GOOD PRACTICE:**
LearningApps example *Game of hangman*

**EXAMPLE OF GOOD PRACTICE:**
LearningApps example *Treasure hunt*

**EXAMPLE OF GOOD PRACTICE:**
Learning scenario *Spatial orientation*

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Interactive learning and edutainment Web site: https://www.funbrain.com (3.7.2019.)
Teach Hub.com:  K-12 News, Lessons & Shared Resources By Teachers, For Teachers :
https://www.teachhub.com/engaging-classroom-games-all-grades (3.7.2019.)
Bebras: http://www.bebras.uk/ (3.7.2019.)
TeacherVision:      https://www.teachervision.com/word-problems/wise-old-owl-steps-problem-solving (3.7.2019.)
Some games for primary school:
https://www.funbrain.com/games/pig-pile 3.7.2019.)
https://www.funbrain.com/games/word-derby (1.7.2019.)
https://www.funbrain.com/games/inkster (1.7.2019.)

# Inquiry Based Learning

Inquiry Based Learning is question- or problem-driven approach to learning based on seeking new knowledge and understanding. It involves students' investigations in order to address questions or solve problems.

Inquiry Based Learning (IBL) is an active approach to learning that includes problem based learning or finding answers for addressed questions. The term refers to discover something new, unknown or untested from the students' view. IBL is a deductive way of learning based on the constructivist theory where students learn skills to synthesise interpret and evaluate the knowledge and the teacher acts as the facilitator. It is a learning-centred approach to teaching with students taking increasing responsibility for their learning and the development of skills in self-reflection.

There are several levels of IBL, customised to suit the students' needs:

- **Structured:** strongly teacher directed. The teacher provides a questions and gives step-by-step instructions for students to investigate the topics.
- **Guided**: The teacher guides the inquiry while students take more responsibility. The teacher helps students to develop investigations, proposes a pool of possible inquiry questions from which students select some.
- **Open**: students take the lead. Students initiate the inquiry process by generating scientific questions and make their own decisions about the design and conduct of the inquiry while the teacher has a supportive role.

Basic teaching method in IBL is conversation that includes one or more research questions. Motivation can start with so called *spark* – a stimulus or challenge provided by the teacher at the beginning of the activity. Students take part in the activity by responding to the 'spark'.

IBL is conducted in phases:
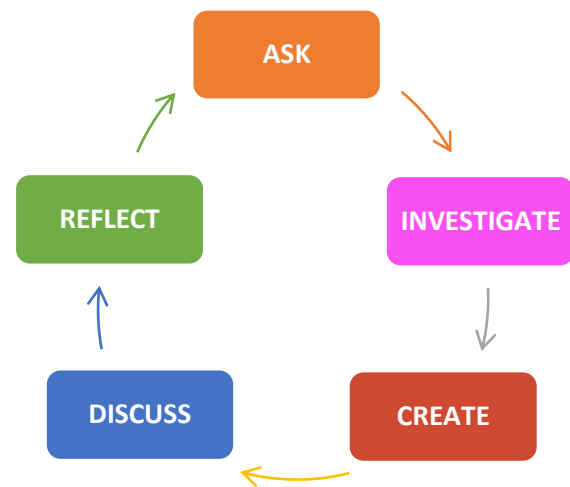


1. Students ask themselves about the learning topic (in structured or guided level explore inquiry questions or formulate their own questions in open level)
2. Students explore resources, experiment and collect information.
3. Students generate new thoughts, ideas and theories that are not directly inspired by their own experience.
4. Students share their ideas with each other and ask others about their own experiences and investigation.
5. Students think again about the initial question, the path taken and the actual conclusions, and maybe repeat the process with some new decisions.

**Project Based Learning** is a form of IBL that involves independent student research. It is based on the concept of collaborative learning where students are assigned a task based on facts or problems that need to be solved or the goal to be achieved.

## Classrom Activities Ideas

Science class, fourth grade:

As a spark teacher can present students a video that shows forests

Research questions:

By collecting old paper, we preserve forests? Why?

Can you calculate how much paper we need to recycle for saving one tree?

Students will:

Investigate and interpret the process of producing paper from wood (search and extract relevant information).

Investigate and interpret the paper recycling process (search and extract essential information).

Create a poster or graphically present both procedures (define algorithm or sequence of commands).

Establish and implement a calculation (write down the steps in the calculation process).

This example can be conducted in the classroom as group work or as a project where students explore research questions at home, collaborate online and present their findings in the classroom.

One of the most commonly used graphic organizers for collaborative learning and brainstorming is the KWL chart:

| KWL | | |
|---|---|---|
| What I Know | What I Want to Know | What I Learned |
|  |  |  |

The letters KWL are an acronym, for what students, in the course of a lesson, already **K**now, **W**ant to know, and finally **L**earn. KWL chart is a graphic organizer to record knowledge, questions and finally acquired knowledge. It is a very good tool for focusing on topic and gathering information, especially in the lower grades of primary school.

## Example

***Waste and Our World*** – Inquiry Based Learning

**Subject:** Science (4th grade)

The activity is performed in groups of 3 or 4 students.

As a **spark** teacher present students a [video "Fruit Decompose"](#) about rotting the fruit and vegetables.

The aim of the class is to closely examine the process of decomposition of perishable food over a 2.5 week time period.

Students formulate the inquiry questions:

- How long does it take?
- Why does it shiver and shrink?
- Why does it change color?
- How is the decomposition rate affected by worms?
- Are there any fruits and vegetables that rot at the exactly the same rate?
- How does temperature influence rotting?
- Why does texture change?
- Do/How come a softer fruit gets molder faster?   …

Students select the sample fruits and vegetables for monitoring.

Each group selects one specimen and starts working in the science lab by observing and documenting the changes of fruit/ vegetable. The list of variables for monitoring is identified: weight, colour, texture, smell, and temperature, and hypotheses are set up about their changes.

Besides collecting the data about defined variables, each group use Google Docs online spreadsheets for daily creating the following information: date, time, picture of the specimen, observation, comment. Teachers are also supposed to give their feedback.

Based on the created online docs and the decomposed specimens in the lab, students share their ideas with each other and ask other groups about their own experiences and investigations.

An expert (7th-grade science teacher) is invited to further discuss and explain the process of decomposition in nature.

Students begin to write blogs reflecting on their work in the lab, about what they had learned, how they had engaged in authentic scientific works, and establish goals for themselves and for their group.

**GLAT Resources**

**EXAMPLE OF GOOD PRACTICE:**
Learning scenario *Nutrition*

Bolte, C., Holbrook, J., & Rauch, F. (2012, September). Inquiry-based science education in Europe: Reflections from the PROFILES project. In First International PROFILES Conference. http://phavi.portal.umcs.pl/at/attachments/2014/0702/114749-profiles-book-final-october2012.pdf (3.7.2019.)

Hoić-Božić, N., Laanpere, M., Pata, K., Franković, I., & Teder, S. (2016). Introducing inquiry-based learning to Estonian teachers: Experiences from the Creative Classroom project. In 2016 39th International Convention on Information and Communication Technology, Electronics and Microelectronics (MIPRO) pp. 1010-1015 (3.7.2019.)

Löfgren, R., Schoultz, J., Hultman, G., & Björklund, L. (2013). EXPLORATORY TALK IN SCIENCE EDUCATION: INQUIRY-BASED LEARNING AND COMMUNICATIVE APPROACH IN PRIMARY SCHOOL. Journal of Baltic Science Education, 12(4). http://d.researchbib.com/f/eno2SdnF5hMKDiLKW0nJAfMKZiZwNkAF85BQpgZGDlAGtjBGDmZF5jMTL.pdf (3.7.2019.)

# Basic Programming Concepts

A computer program is a sequence of commands executed in the exact order. It tells the computer how to interact with hardware, interact with the user and how to process data. The program is written in the programming language, a language which the computer understands. To write a program is necessary to know the basic programming concepts.

Programming languages are used for writing computer programs. Each programming language has:

- Alphabet - character set used
- Syntax rules (grammar) description of commands and data, rules of consignment of commands
- Semantic rules - describe the purpose, meaning, action performed by the command.

Each programming language uses a set of words of special significance called the keywords.

In the lower grades of primary school it is best to start with Visual programming languages where the program code is presented in blocks. It is not necessary to learn the syntax because the program is created by stacking the blocks. Some of the most popular programming environment for learning are Code.org, Blockly, Scratch, Tynker and Run Marco!

Regardless of the chosen programming language, it is necessary to explain the basic programming concepts used for coding. They are:

- Sequence
- Loops (Iteration)
- Variables
- Branching (if condition).

The sequence is a concept which explains that the commands in the program are needed to be specified in a certain order. The teacher can give examples such as moving along the path (Code.org-Puzzle 1), executing actions or collecting objects (Code.org-Puzzle 3).

The loop is a construct that causes a group of one or more statements to be invoked repeatedly until some end condition is met. It can be used when the number of repetitions is known in advance or when the end condition is not limited to the number of repetitions. Loops are commonly used in games when moving characters, performing the actions, or collecting objects (Code.org-Puzzle 3). Examples of loops are available at RunMarco! (level 11) or Code.org: Code with Anna and Elsa.

## Classrom Activities Ideas

Students play game RunMarco! and practice basic programming concepts.

Students design their own story in Scratch, where a character should move around different backgrounds, skip obstacles, and collect specific items.

When coding sometimes it is necessary to keep certain values while the program is running. **Variables** are used for that purpose.

Variables have name and value and can store different types of data including numbers, single characters, text strings and multimedia content. The value of a variable can change throughout a program is running.

Toolbox

When using variables in games we can store time left to finish the game, determine the number of lives, collected items, points, text or sound what characters can say. Examples of using variables in games are available at Blockly Games: Turtle or Code club: Scratch–Ghostbusters.

The program can take certain routes depending on the fulfilled conditions. It is called branching. For example, you could test an input by the user and respond with the message accordingly. Due to conditionals, a program can work differently every time it runs.

Examples of using branching in games:

- to move characters
- to change values of variables (lost life, gathering points)
- to show or hide characters/items
- to end the game

Most common branching is executed with if-then-else clause:
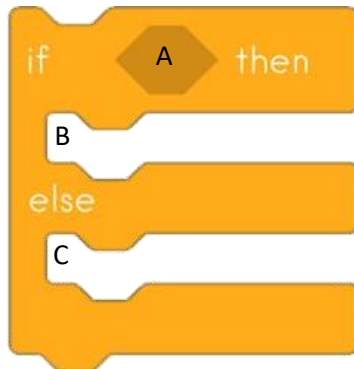


### GLAT Resources

**EXAMPLE OF GOOD PRACTICE:** Scratch Game *King & Evica*

**EXAMPLE OF GOOD PRACTICE:** Scratch Game *Even numbers*

**EXAMPLE OF GOOD PRACTICE:** Game/story scenario *Hlapić plays with words*

where **A** represent condition, **B** set of commands to be executed if the condition is fulfilled and **C** set of commands to be executed if the condition is not fulfilled. The condition is set with relational operators (>, <, =) or logical operators (AND, OR, NOT).

Examples of using variables in games are available at Blockly Games: Bird or RunMarco! (level 31).

Learning to programming children are practicing problem solving skills as well as critical and logical thinking.

### Example

Students can practice basic programming concepts by building a correct code, or by debugging exiting code by rearranging and changing blocks.

Educational App Store: https://www.educationalappstore.com/best-apps-for-kids-and-students (15.6.2019.)

Coding Google Doodle!: https://www.google.com/doodles/celebrating-50-years-of-kids-coding?doodle=32615474&domain_name=google.com&hl=en (15.6.2019.)

Flipped Classroom Tutorials: Scratch Coding A complete overview for Beginners https://www.youtube.com/watch?v=K0T7zuxEIgw (6.7.2019.)

Scratch wiki – Programming: https://en.scratch-wiki.info/wiki/Programming (6.7.2019.)

# Visual programming language Scratch

Scratch is a block-based visual programming language and online community. It is a free educational tool, which enables us to create interactive stories, games and animations. Scratch encourages young people to think creatively, reason systematically, and work collaboratively, which means developing essential skills for life in the 21st century.

Computer literacy is a key skill acquired through education. An important part of computer literacy in today's society is also the ability to code or to program.

**Computer programming** is the process of developing and implementing various sets of instructions to enable a computer to do a certain task. In order to communicate with a computer (and to get it to execute those instructions) people must speak its language.

**Programming** language is a machine-readable language, which comprises a set of instructions that produce various kinds of output. There is a lot of different textual and visual programming languages (e.g. C++, Java, Python, Snap!, Scratch, etc.) and each is based on its own unique syntax (grammatical structure) and semantics (meaning). Each programming language is used for a different purpose. **Visual programming language** (VPL) is any programming language that lets users create programs by graphically manipulating program elements. Instead of writing code, for example in Python, in visual programming languages code is created using blocks:
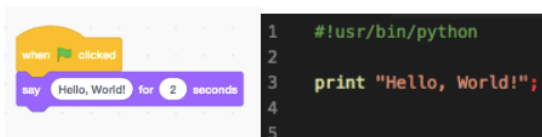


One of the most popular visual programming languages is **Scratch.** It was primarily designed for children aged between 8 and 16, but is used by people of all ages.

## Scratch in classroom

Scratch is an appropriate tool for different ages and starting knowledge level students, both beginner and advanced learners. Educators can use it as a tool for presentation, motivation, exercise, collaboration and the most important as a tool for learning programming.

**Classroom Activities Ideas**

Students can create their own interactive digital instruments by using multiple controls and shortcuts into the instrument's functionality and design.

Students create a classic game (e.g. maze) or use their imagination to design new games where the player leads the character from start to end position.

Educators can use Scratch in classroom in two ways:

*1. Teaching and learning programming with Scratch*

Scratch is often used as a beginning language for teaching people to code. In Scratch learners create interactive stories, animations and games.

With creating projects, they achieve basic and advance programming concepts (e.g. algorithm, data type, variable, loop, etc.). Educators, who teach programming in Scratch, must have programming knowledge.

## 2. Using prepared projects in Scratch

Scratch is not only a visual programming language but is also an **online community.** There is a collection of users' projects (e.g. games, stories, animations, etc.). Teachers could find projects for a topic they need and use prepared projects in the classroom. Another option is for teachers, if they have some basic skills to work in Scratch, to create their own projects, on subjects and topics they teach and use it in the classroom for achieving the learning objectives.

### Creating with Scratch

On [Scratch web site](#) we can *Create* new projects and *Explore* existing. For saving and modifying games one should create a Scratch account. For creating, saving and sharing projects the user clicks on the *Start Creating* button.
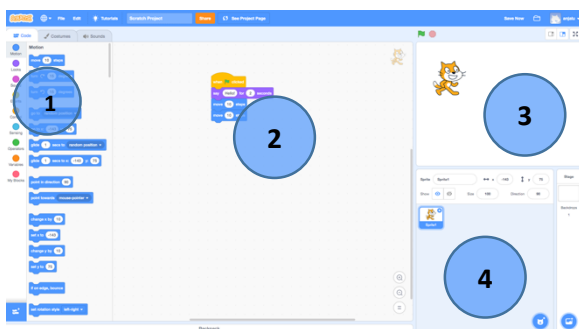


*Figure 2: Scratch create window*

Scratch user interface window is very simple. As shown on *Figure 2*, it has four main panes: (**1**) Command palette (**2**) Scripts (**3**) Stage and (**4**) Sprites.

**Command palette** with commands of nine categories such as Motion, Looks, Sound, Events, Control, Sensing, Operators, Variables and My Blocks. Command blocks are colour-coded by category, helping users find related blocks.

**Scripts area** is where users drop a command, which they drag from the command palette and build a script for currently selected sprite.

**Stage** is the place where the action happens. Here one could see what happens when one compiles the program (script).

**Program** is the sequence of commands in scripts area.

The bottom-right pane shows images of all **sprites** in project. The currently selected sprite (the one for which we build a script) is highlighted. Here we can also chose background images for the stage.

 Example

### *Let's eat healthy!* – Scratch game

**Subject:** Science (2nd grade)

**Link:**
[https://scratch.mit.edu/projects/325739167/](https://scratch.mit.edu/projects/325739167/)

This game designed in Scratch has four levels:

1. **Collect healthy groceries:** The player moves left and right using the arrows keys on the keyboard to collect healthy groceries in the basket. The player should avoid unhealthy food.
2. **The maze:** Using the arrows on the keyboard (up, down, left, right) the player moves through the maze and avoids obstacles and unhealthy food to reach the cereals.
3. **The wall:** The player should arrange the words of the phrase *Healthy food – healthy life!* in the correct order.
4. **Setting the table:** There is a spoon, fork, knife and dessert spoon on the table. The player's task is to properly set the table for lunch.

 GLAT Resources

**EXAMPLE OF GOOD PRACTICE:** Scratch game *Computational Castle*

**EXAMPLE OF GOOD PRACTICE:** Scratch game *Let's eat healthy!*

**EXAMPLE OF GOOD PRACTICE:** Learning scenario *Playing and calculating up to 20*
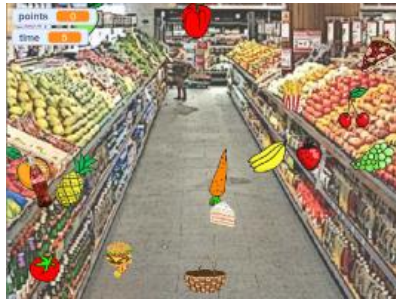
Maloney, J., Resnick, M., Rusk, N., Silverman, B., & Eastmond, E. (2010). The scratch programming language and environment. ACM Transactions on Computing Education (TOCE), 10(4), 16. (6.7.2019.)

Flipped Classroom Tutorials: Scratch Coding A complete overview for Beginners https://www.youtube.com/watch?v=K0T7zuxEIgw (6.7.2019.)

Scratch wiki – Programming: https://en.scratch-wiki.info/wiki/Programming (6.7.2019.)

# Digital Storytelling

Digital storytelling is a process of telling stories by integrating multimedia elements (images, sound, text, animation) using digital tools. By engaging in the process of designing and creating digital stories, students can develop algorithmic thinking skills as well as many other skills such as research, organization, digital literacy, and problem solving skills.

Digital storytelling has been recognized as an effective way of achieving learning goals. By combining the steps of the traditional storytelling process with gathering and creating digital media, teachers can encourage their students to become creative narrators, enable them to acquire many generic skills, as well as to achieve specific learning outcomes of different school subjects.

Key elements of the digital story are:

- setting of the story,
- characters,
- scenes,
- sequence of events,
- narrative perspective (point of view).

The teacher can start the **digital storytelling process** by selecting a topic and, with the help of students, formulate the initial **ideas** about the story and define its purpose and target audience. The teacher then guides students in **exploring** the topic and gathering necessary information. In this step, students construct knowledge and organize ideas.

Students should decide regarding appearance, personality traits, and motivations of **characters**, describe the setting of the story (time and place), formulate the problem faced by the characters, how it is approached, and about its outcome. To make stories interactive, **game elements** can be added. For example, challenges like labyrinths, brain teasers, sorting games and puzzles that should be solved by **the player** (the playing character). The above mentioned games will enable the player to develop algorithmic thinking skills.



Besides the player, stories can have a **narrator**, a non-playing character who guides the player through the game and gives instructions and feedback, as well as other non-playing characters.

In the next step a **script** should be defined. The initial ideas need to be further developed and the text that will be shown or told by characters -prepared. The teacher should help the students to write an interesting, as well as focused and concise story that it is easy to understand.
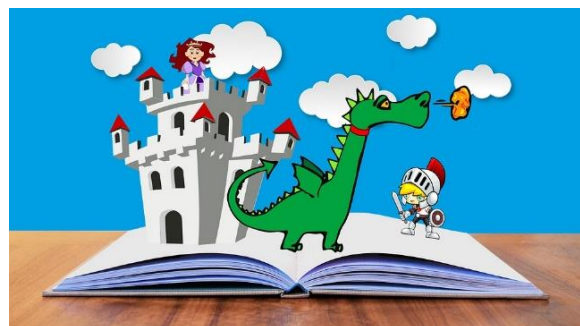
Before the actual work on creating the digital story using the chosen tool, the **storyboard** is usually created. It is a written or graphical representation of all the elements that will be a part of the story including media files (images, text, narration, music).

In the process of designing interactive stories with game elements students have the chance to develop their algorithmic thinking skills and learn basic programming concepts:

- **sequence** – students arrange the elements in the chronological order in which they will appear in the story,
- **data** – students define which data need to be stored (e.g. player's name, collected points, remaining time,…)
- **conditions** – students direct the story flow, define how the player will collect points, define end of the game,…
- **loops** – students define challenges for player, decide how many attempts will the player have to finish the game, etc.

After **combining** all elements together and **sharing** the created story with others, the final step of the process is gathering feedback and **reflection**.



### Classroom Activities Ideas

Students illustrate events from their lives or a story from their favourite fairy tale.

After visiting a food market, students design the story about the girl who wants to prepare healthy meals.

After researching about cultural sights of their region, students present them using a story and design games in which the player should demonstrate the knowledge of these sights.

Students illustrate a real-life mathematical problem and design logical games combined with mathematical tasks in which the player needs to apply knowledge to achieve the goal of the game.



### Toolbox

Multimedia:

Visual programming languages:

**Using Scratch for digital storytelling**

A visual programming language Scratch can be used for creating digital stories. Scratch offers a library with numerous sprites (characters), backgrounds and sounds so even younger students can easily create simple digital stories. As they code, students develop algorithmic thinking since they need to:

- **formulate a problem** – determine which Scratch elements they should use,
- **logically organize and analyse data** – create characters, scenes and sequencing by building blocks of code,
- **represent the data** – tell the story by defining movement of characters and dialogs among them, define variables for collecting points and timers,
- **identify, analyse, and implement solutions** – ensure that the program works as intended, in the ordered steps.

### Example

*Seasons* – **Interactive digital story with game elements created in Scratch**

**Link:** scratch.mit.edu/projects/303731915

**Subject:** Science (1st grade)

**Learning outcomes:**

- Connect clothing items with particular season
- Recognize fruit and vegetables characteristic for a particular season
- Write the names of the seasons.

**Story:** Girl Mia moved from Africa to Croatia and wants to learn about the seasons: what to wear, what to eat, as well as names of the seasons.

**Game elements:** A player should successfully solve three tasks for each season, starting from the summer. In the first task, the player needs to choose appropriate clothes for Mia. When the player successfully solves this task, he/she moves to the second task where fruits and vegetables characteristic for the season should be collected in the bowl. The final task is to write the name of the season that follows.

While solving the tasks, the player collects points. If enough points are collected, the goal of the game is achieved which means that the player has good knowledge of the seasons.

## GLAT Resources

📄 **TEMPLATE:** *Game/story scenario template*

📄 **EXAMPLE OF GOOD PRACTICE:** Game/story scenario *Seasons*

📄 **EXAMPLE OF GOOD PRACTICE:** Learning scenario *The fruits of the seasons*



Gamification and Storytelling:
https://www.researchgate.net/publication/315518111_Gamification_and_Storytelling (6.6.2019.)

Digital storytelling module (Advanced level):
https://www.slideshare.net/Fundacionesplai/tma-advanced-m2

How to Use Scratch for Digital Storytelling:
https://www.commonsense.org/education/articles/how-to-use-scratch-for-digital-storytelling (6.6.2019.)

Hoić-Božić, N., Holenko Dlab, M., Mezak, J., Ursić Budim, Sara, Development of Computational Thinking Skills in Primary School through Digital Storytelling with Scratch, The 10th International Conference on eLearning (eLearning-2019), 2019, Belgrade, Serbia

# Micro:bit

| | The micro:bit (also referred to as BBC micro:bit) is an open source hardware designed by the British Broadcasting Corporation (BBC) for use in computer education. The BBC micro:bit is a handheld, programmable micro-computer that can be used for all sorts of creations, from robots to musical instruments. |
|---|---|

The micro:bit was designed to encourage children to get actively involved in writing software for computers (coding) and building new things, rather than being passive consumers of the information technology media.

The micro:bit, measuring just 4 cm by 5 cm, is a stripped-down computer which children can use to code and create anything they set their minds to. It is intended as a starter device to give children a basic introduction to physical computing and tinkering so that they can move on to using more advanced devices such as an Arduino or Raspberry Pi.

Micro:bit contributes to empowering the students - 90% of students say it helped show that anyone can code!
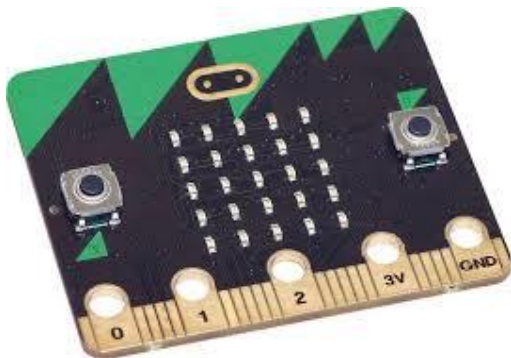


## Technical characteristics

The device is described as half the size of a credit card and has a display consisting of 25 red LEDs, two programmable buttons, an on-board motion sensor or "accelerometer", a built-in compass or "magnetometer". It connects by Bluetooth Smart Technology and has three input and output (I/O) rings.

To code micro:bit online editors are used, for example, the MakeCode editor.

## Let's code!

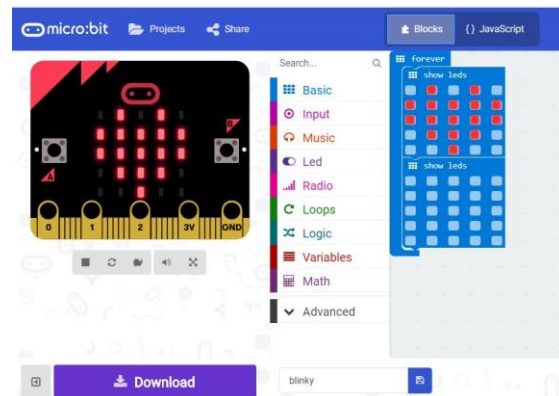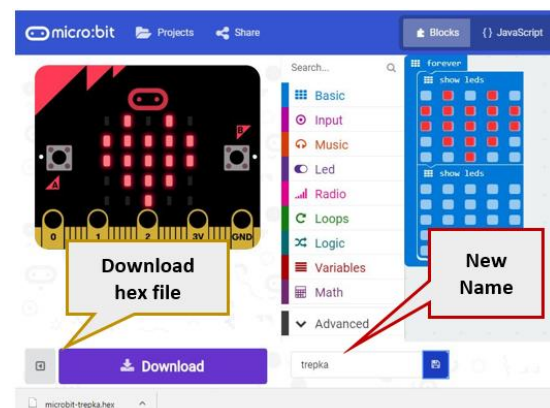*Prior Learning*

Students should ideally be familiar with:

- opening a web browser and entering a URL (address of a website),
- copying files by dragging their icon from one location to another,
- block based programming environment, such as **Scratch**.

The coding with online editor like MakeCode entails the following 4 steps:

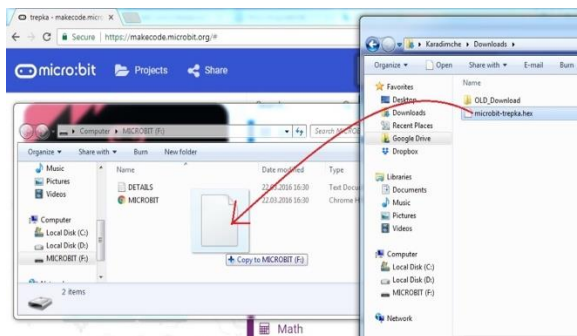### Step 1: Code it (or find code)



### Step 2: Download code to PC

**Step 3: Connect the micro:bit with USB cable**

**Step 4: Transfer code from PC to micro:bit**

## Toolbox

Online editor:

micro:bit

Visual programming languages:

Scratch    microBlocks
Small, Fast, Human Friendly

Educational resources:

micro:bit    Mind+

## Example

*Find the shortest path* - **A strategy development and competition game with micro:bit**

**Subject:** Science (1st grade)

**Learning outcomes:**

- Determine the length of the path (in number of steps)
- Develop a strategy to find the shortest path out of the maze.

**Task:** Students needs to develop a strategy to get out of the maze with a minimum number of steps.

**Procedure:** This game can be played as single player or multiplayer game. Each player has one micro:bit.

First, students can play the game as a single-player game. Each student is placed in the middle of the maze drawn in the classroom and have to find the shortest path out. The students wear micro:bit on their foot and it serves as a pedometer - it counts the number of steps. By playing the game, students can develop different strategies (big steps, jumps, analyse the space around them, optimize the path).

Then, two or three students (depending on the size of the maze) play the game at the same time. Now they have to finish the game first with the minimum number of steps, taking into account the extra obstacles (other players).

## Classroom Activities Ideas

Students can practice addition in pairs. Each student needs a micro:bit which will show a random number from a given range after a shake. The task for students is to sum the displayed numbers.

If a random letter is displayed on the micro:bit, students can write down that letter, indicate which letter precedes or follows in the alphabet, or think of words that begin with that letter.

Students can compose simple tunes and play them. Previously, a speaker should be connected to micro:bit.

Micro:bit has a temperature sensor so students can measure current temperature in the classroom. They can collect data and write it on the prepared paper template during a certain period of time.

https://engagingcreativeminds.org



To decide who the winner is individual result can be calculated as a sum of the number of steps and number of seconds used to find the way out.

When all the students finish the task, the teacher can discuss the different strategies that were used. To count the seconds, a mobile phone or another micro:bit can be used.

Instructions to code a pedometer:
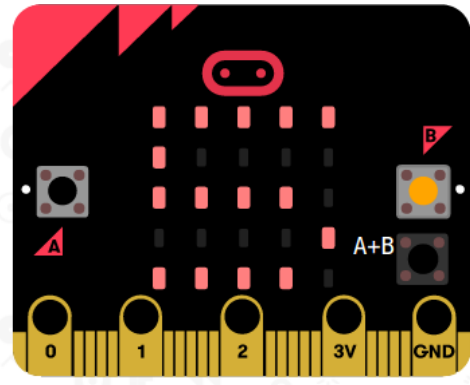
▪ https://makecode.microbit.org/projects/step-counter

Instructions to code a timer:

▪ https://codeclubprojects.org/en-GB/microbit/against-the-clock/

**GLAT Resources**

**EXAMPLE OF GOOD PRACTICE:**
Learning scenario *Playing and calculating up to 20*

Introduction to the BBC micro:bit: https://codeclubprojects.org/en-GB/resources/microbit-intro/

All about micro:bit: https://microbit.org (3.7.2019.)

Using the micro:bit editor: https://codeclubprojects.org/en-GB/resources/microbit-editor/ (4.7.2019.)

Lessons and projects for micro:bit: https://microbit.org/ideas/ (3.7.2019.)

10 Micro:Bit Projects in 10 days: https://www.element14.com/community/community/stem-academy/microbit/blog/2016/05/26/10-bbc-microbit-projects-in-ten-days (3.7.2019.)

Example activities, Barefoot Computing - http://barefootcas.org.uk/(4.7.2019.)
Example activities, "Code-IT" website - http://code-it.co.uk/csplanning.html (4.7.2019.)

# Part II:
# Annexes

**Annex 1: Learning scenario template**

| | |
|---|---|
| Learning Scenario Title | |
| Course/Grade | |
| Learning Outcomes | *General learning outcomes*<br><br><br><br>*Specific LO oriented on algorithmic thinking* |
| Aim, Tasks and Short Description of Activities | |
| Keywords | |
| Correlation and Interdisciplinarity | |
| Duration of Activities | |
| Learning and Teaching Strategy and Methods | |
| Teaching Forms | |
| Tools | |
| Resources/Materials for the Teacher | |
| Resources/Materials for the Students | |

| Teaching summary | Motivation-Introduction | | Duration |
|---|---|---|---|
| | Implementation | | |
| | Reflection and evaluation | | |
| Annexes | | | |
| Examples and game references | | | |

**Annex 2: Worksheet template**

Name and surname, class:

_____

> ## Title
> **Task** – Text
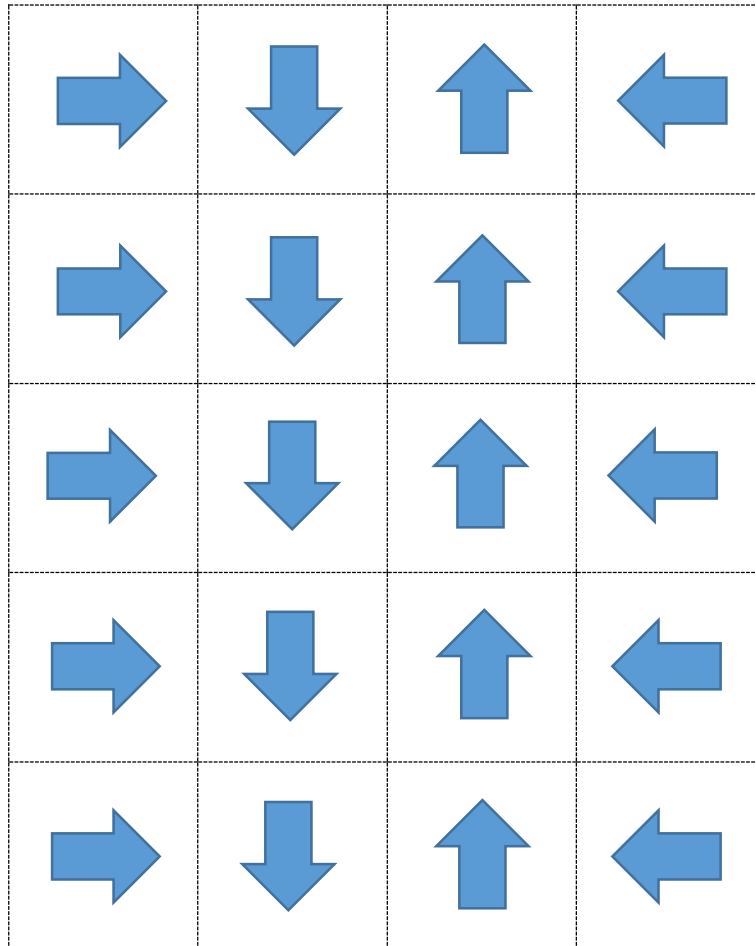
## Annex 3: Game/story scenario template

| | |
|---|---|
| Title of the game | |
| Type<br>*(Scratch or micro:bit)* | |
| Course/ Grade | |
| Learning outcomes | |
| Goal of the game | |
| Characters and their roles | |
| Description of the game flow | |
| List of scenes / backgrounds | |
| Logical tasks within the story<br>*(Note: select tasks that are aligned with your learning outcomes)* | |
| End of the game | |

### *Appendix - Instructions for Storytelling in Scratch*

The basic idea is to encourage students' algorithmic and computational thinking by including them as much as possible in designing the game/story, rather than just playing/reading it when finished.

Using Scratch, the whole story, which should have at least one logic game, will be designed. This game is used to direct the flow of the story according to the "if ... then ... else" principle as one of the algorithmic thinking concepts we would like to encourage in students.

The story will be designed together with the students, the amount of their participation will depend on their age. You should estimate how much help has to be provided to your students in this process.

For example, with the students you can design: **characters** (who will be the main character, who will be supporting characters, what they will look like, what they will do in the game,…), **scenes** (how many, what will they represent, what objects will be placed on them,… ), the **goal and flow of the game** (what we want the main character in the game to do and achieve during the game), the **text** (written on the scene, or in the "bubbles", ...), **logical tasks** ("obstacles" for the main character which must be resolved or "skipped" because the continuation of the game depends on it (according to "if ... then ... else" model).

For logical tasks, students can also be asked, for example, what items are collected, what they look like, what elements will be "wrong", how points are gained or subtracted in the game, how to move a character towards a given object, etc.

The recommendation is that the story has no more than 3-4 scenes that are connected with 2-3 logic games to achieve the "if ... then ... else" flow of the game. The end of the story should depend on the results of the logic games played, so the endings of successfully solved games should differ from the endings of unsuccessfully solved games.

**Annex 4: LePlanner instructional sheet**

**Creating a visual representation of a learning scenario**

| | |
|---|---|
| **Learning Scenario Title** | **On LePlanner: See** Create New Scenario Portal: <br><br> 1. Give Title <br> 2. Describe the scenario <br> 3. Save inputs |
| **Course/Grade** | **On LePlanner:** See activities under the **Details** Menu: <br><br> 1. Indicate subject area <br> 2. Indicate the grade |
| **Learning Outcomes** | **On LePlanner:** See Learning outcomes under the **Details** menu: <br><br> 1. Add your lesson outcomes (note you can as many objectives as it suits your lesson). |
| **Aim, Tasks and Short Description of Activities** | **On LePlanner:** See activities under the **Details**: <br><br> 1. Activities (as many as it suits your lesson) <br> 2. State the specific learning outcome expected from the activity (aim) as related to the overall learning outcomes. |
| **Keywords** | **On LePlanner:** See Tags under the **Details** Menu: <br><br> 1. Enter tags associated with the lesson |
| **Correlation and Interdisciplinarity** | **On LePlanner**: See **Description** under the **Details** Menu: <br><br> 1. Mention the related disciplines in the description. |
| **Duration of Activities** | **On LePlanner:** See Activities under the **Details** Menu, under **Duration**: <br><br> 1. Indicate the course duration |
| **Learning and Teaching Strategy and Methods** | **On LePlanner:** See activities the **Details** Menu, look under **Activities**: <br><br> 1. Indicate whether the activity will be done in class or out of class (possibility of creating a blended learning or flipped class) |
| **Teaching Forms** | **On LePlanner:** See the **Details** Menu, look under **Activities**: <br><br> 1. Indicate the type of learner engagements (eg. Individual work or group activity). |
| **Tools** | **On LePlanner:** See activities the **Timeline** Menu: <br><br> 1. Teacher Resources, <br> 2. Student Resources. |
| **Resources/Materials for the Teacher** | **On LePlanner:** See activities the **Timeline** Menu: <br><br> 1. Define teacher resources with reference to Activities as shown on the **visually displayed scenario timeline.** <br> 2. Adding tools and materials (Requirements: a. Resources name, , b. Conveyor, and c. Display) |

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| Resources/Materials for the Students | See **Timeline**, under **Student Resources** add the resources,<br><br>1. Resources<br>2. Conveyors<br>3. Display | |
|---|---|---|
| **Teaching Summary** | Motivation-Introduction<br><br>1. See **Timeline**, under **Teacher Resources** add the texts to this effect. | Duration |
| | Implementation<br><br>See **Timeline**, under **Teacher Resources** add the texts to this effect. | |
| | Reflection and evaluation<br><br>See **Timeline**, under **Teacher Resources** add the texts to this effect. | |
| **Annexes** | | |
| **Examples and Game references** | Hyperlink material or resources to this effect. | |

# Annex 5: Learning scenario "Rhythmic and dance structures"

*Author: Mate Verović*

| | |
|---|---|
| **Learning Scenario Title** | Rhythmic and dance structures / Folk dance selected from the native region |
| **Course/Grade** | Physical Education<br><br>4th grade of primary school |
| **Learning Outcomes** | **Learning outcomes focused on general subjects:**<br><br>• Develop nerve-muscular motion control with an emphasis on the development of coordination, flexibility and rhythm<br>• Dance homeland folk dance „Crikvenički tanac"<br>• Identify the cultural heritage of their homeland<br><br>**Learning outcomes focused on algorithmic thinking:**<br><br>• Realize the repetitive parts of the dance<br>• Link the melodic parts of a tune with specified parts of the dance<br>• Convert the structural parts of the dance into a sequence of commands<br>• Display the dance structures in the proper order using coded labels |
| **Aim, Tasks and Short Description of Activities** | Learn a few dance structures of Crikvenica's traditional dance by watching a YouTube video and using algorithmic thinking. Students will first listen to the music background by analysing melody and rhythm of the tune. Then the parts of the song will be labelled with the agreed marks. The following step is learning of the dance structures and finally labelling the entire dance performance with the agreed marks in a way that each dance structure is connected with the corresponding part of the music background. If there is time left, the students will create a new dance with different order of dance structures for the same music background with the help of coded characters.<br><br>Students will be introduced to the term algorithm/loop as a series of commands that repeat a particular number of times. |
| **Keywords** | Loop, dance structure, repeat, rhythm, algorithm, command, folk dance |
| **Correlation and Interdisciplinarity** | Physical Education, Music, Informatics |
| **Duration of Activities** | 60 minutes |
| **Learning and Teaching Strategy and Methods** | Active learning method, collaborative learning, problem solving, using dialog, watching and demonstration methods, solving worksheet, practical work, dance, dramatization |
| **Teaching Forms** | Frontal teaching<br>Work in pairs<br>Group work |
| **Tools** | - |

| Resources/Materials for the Teacher | Youtube, Canva, photos of the dance, ingredients and tools for preparing a sandwich | |
|---|---|---|
| Resources/Materials for the Students | A4 paper sheet for introductory part, worksheets, felt pen, pencil | |
| Teaching Summary | **Motivation-Introduction** | Duration |
| | The teacher demonstrates an already prepared sandwich, which consists of a bun in which the ingredients have been put according to the following order: a layer of cucumbers, a layer of cheese, a layer of ham, a layer of cheese, and a layer of tomatoes. The students are divided into four groups consisting of four members. Each group has to design an order of commands within 5 minutes so that the teacher/robot can make a sandwich identical to the demonstrated one (unsliced bun, cheese, ham, vegetables in one piece, which will require certain pre-activities in order to prepare the sandwich). Each group writes down a set of commands and one student from the group reads aloud the order of commands. | 15 min |
| | The teacher/robot carries out the commands through dramatization, which leads to a more or less successful goal. The winner is the group that creates the most precise set of commands for making a sandwich. After the successfully competed task students are introduced to the term „algorithm" as a series of commands leading to the solution. The students discover the meaning of the word „algorithm" on a concrete example. They notice an organised conduction of a series of commands in order to achieve the goal. Moreover, they realise that some commands are repeated (cheese) – the term „loop". | |
| | **Implementation** | |
| | A lesson of the dance structures of the traditional dance „Crikvenički tanac" is announced. The students first listen to the music background of the dance from Youtube (0.08 – 2.30). They notice rhythmical-melodic recurring patterns (loops), and also the oscillation in the tempo. The first task is to recognize the pattern of the recurring change of the tempo. When the tempo is slower, the students have to slowly walk around the hall, and when the tempo quickens, the students jump. | |
| | They notice that the two kinds of tempo are alternatively constantly repeated and are therefore labelled with the letter „B" (quick part) and with the letter „P" (a transition between the two quicker parts). With the repeated listening it can be noticed that each of the two tempos is repeated five times, usually one after the other starting with the „P" part. | 35 min |

| | The students are divided into eight pairs followed by learning dance structures watching a video from Youtube. The teacher demonstrates and helps the students if needed. Students learn part by part of the dance in order as shown in the video. The dance consists of ten shorter parts, five quicker marked with the letter „B" and five parts of a slower tempo marked with the letter „P" during which six simpler dance structures alternate. The students immediately notice that some dance structures repeat. While rehearsing all six dance structures, they notice that three dance structures belong to the „P" part, and three to the „B" part. One pair of students demonstrates three dance structures from the „P" part which are marked as „P1", „P2" and „P3". The same is repeated with the „B" part. | |
| --- | --- | --- |
| | **Reflection and evaluation** The students work in existing pairs. Every pair gets worksheets, in which the labels of all six dance structures are stated and a small photo is put next to each structure as additional help in recognition. While watching the video from YouTube the students have to write down the exact order of dance structures/commands (algorithm) for the set dance. The students who conduct this activity faster get a task to create a new algorithm of commands with the existing labels („P1", „P2", „P3", „B1", „B2", „B3"), for the same music background, and to demonstrate it through dance. | 10 min |
| **Annexes** | Worksheet "Crikvenički tanac dance" Photos of dance structures with labels | |
| **Examples and Game references** | Video „Crikvenički tanci" (0.08 – 2.30). Available online: https://www.youtube.com/watch?v=PPNbH1shbJI (30.7.2018) Photos of dance structures – https://www.google.hr/search?q=tradicijski+plesovi&hl=hr&source=lnms&tbm=isch&sa=X&ved=0ahUKEwjDn7G178TaAhXMDOwKHYzlApAQ_AUICigB&biw=1280&bih=650 (30.7.2018) | |

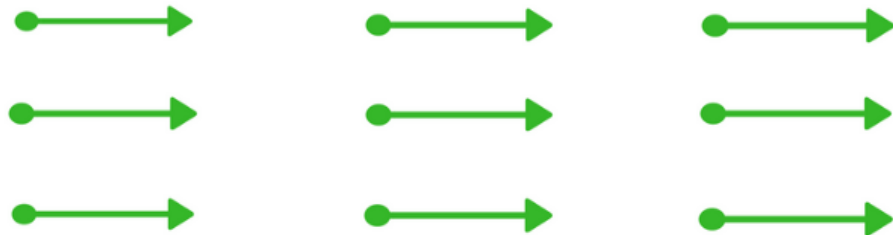**Annex 6: Worksheet "Crikvenički tanac dance"**

---

„Crikvenički tanac" dance

Task - Convert the structural parts of the dance into a sequence of commands using the given labels (P1, P2, P3, B1, B2, B3)

---

# Algorithm – „Crikvenički tanac" dance

# FAST PART 1

# B1



# FAST PART 2

# B2

# FAST PART 3

## B3



# TRANSITION 1

## P1

# TRANSITION 2

## P2



# TRANSITION 3

## P3

# Annex 7: Learning scenario "Playing and revising about the traffic"

*Author: Sonita Penavin*

| | |
|---|---|
| **Learning Scenario Title** | Playing and revising about the traffic |
| **Course/Grade** | Science, Homeroom class (topic "Personal and social development") <br><br> 2nd grade of primary school |
| **Learning Outcomes** | **Learning outcomes focused on general subjects:** <br> • Notice traffic signs for pedestrians <br> • Distinguish, name and compare bus station, train station, airport and shipping port <br> • Describe the importance of traffic connections in the homeland <br> • Name the professions related to the traffic and means of transport <br> • Connect knowledge about traffic signs, means of transport and behavior in traffic into a logical unit <br> • Apply knowledge in everyday life situations <br> • Review own traffic culture <br><br> **Learning outcomes focused on algorithmic thinking:** <br> • Use the if command <br> • Find different, but the shortest solutions for achieving a certain goal (the shortest path in the game) |
| **Aim, Tasks and Short Description of Activities** | By playing the game according to the rules, students revise subject matter about traffic, means of transportation and traffic signs within the Science course. In the homeroom class, students learn about the decision concept, how to make a decision and about its consequences. In the game TRAFFIC, students will practice the application of the decision making model on examples by rolling a die, answering the questions, making decisions and accepting the responsibility. <br><br> - - - - <br><br> Students will use the if command to revise the subject matter, play the game according to the rules - answer all the questions and reach the goal as fast as possible. |
| **Keywords** | - means of transportation (train, bus, airplane and ship), traffic signs <br> - decision, consequence, choice <br><br> — — — <br><br> - algorithm, command, a condition for making the decision, if command |
| **Correlation and Interdisciplinarity** | Mathematics, Homeroom class, Informatics |
| **Duration of Activities** | 90 minutes |

| | |
|---|---|
| **Learning and Teaching Strategy and Methods** | Game Based Learning<br>Dialogical method<br>Demonstration method<br>Problem solving method |
| **Teaching Forms** | Frontal teaching<br>Individual work<br>Group work (5 students) |
| **Tools** | - |
| **Resources/Materials for the Teacher** | Sketchpad, Canva, Microsoft Word for preparing materials |
| **Resources/Materials for the Students** | Game rules, question cards, score table and game board.<br>Die<br>Pawns<br>Pen (for game leader) |

| | | |
|---|---|---|
| **Teaching Summary** | **Motivation-Introduction** | Duration |
| | Introductory conversation of the teacher and students about their way of arrival to and departure from school. | 20 min |
| | The conversation include questions like: Do they come on foot, by car, by bus? What traffic signs do they see on the road? Do they always use the same route? Is there another way to go to school? Is a particular route longer or shorter? ...). Based on discussion about longer or shorter routes, we repeat the model of decision making and its consequences (the decision is what we have chosen). | |
| | *Examples:* | |
| | *If I use the long way I have to wake up early, otherwise, I can sleep longer.* | |
| | *If it rains, will I wear rubber boots, or clothes sneakers?*<br>*(WHY? - So that my legs don't get wet and I don't get cold).* | |
| | — — — | |
| | Repeat the concept DECISION | |
| | -if-then-else (In everyday life we also make decisions. For example: **If** I get a good grade, **then** I can play games longer, or **else** I have to learn more.) | |
| | **Implementation** | |
| | **1st activity:** The teacher divides the students into groups of 5 students (4 players and game leader). Benches are moved and connected so that the students can sit in groups. | 50 min |
| | With the help of two students, teacher demonstrates the rules and then distributes the working materials (question cards, score tables, dice and pawns). | |
| | **2nd activity:** Playing the games (in groups of 5 students) | |

At the beginning of the game, each student roles a die. The student with the highest number becomes the game leader. The leader gets a paper where she/he writes the players' names and keeps the scores. During the game, she/he is in charge for reading the questions from the cards. She/he also writes "C" for every correct answer or "I" for every incorrect answer as well as how many times the player stopped on one of the numbered fields (by putting the mark X for each stopping).

The aim is to reach the end of the path on the game board by stepping on as few fields as possible.

The player who rolled the smallest number starts the game. The player sitting on her/his right side plays next. The game starting point is the picture of a traffic light (🚦). Players move their pawns forward along the path by the number of fields indicated on the die. If the pawn ends on a field occupied by an opponent's pawn, the opponent's pawn is returned two fields backwards.

Explanations of specific fields:

or - Upon arrival in the fields with these traffic signs, the player has to roll an even number to continue the game. Otherwise, she/he pauses a round.

- By coming to this field, the player takes one of the question cards and answers the question. If she/he answers correctly, she/he can roll the die and move forward according to the number indicated on the die. If her/his answer is incorrect, she/he needs to remain in that field until the next roll.

or - Upon arrival in the fields with these traffic signs, the player moves her/his pawn backwards for the number of fields that represents the smallest multiplier of the number indicated on the die.

or - By coming to the fields with these traffic signs, the player can move forward for two fields, if she/he explains exactly their meaning. Otherwise, she/he remains in that field until the next roll.

 ,  ,  ,  or



- Upon arrival in these fields, the player has to decide whether to use a shortcut to reduce the number of fields that he will step on or resume the game without using the shortcut. If the player decides to use the shortcut, he needs to take two cards and answer the questions correctly. Otherwise, he needs to take the longer path.

A game winner is the one who has the most correct answers and first reaches the end of the path.

| | | |
|---|---|---|
| | **Reflection and evaluation** | 20 min |
| | Discuss with the students about the game using the following questions: How did you like it? Was it interesting, difficult, tense, ...? Do you have any new suggestions/ideas for the game? Do you like this method of subject matter revision? . . . | |
| | What were the consequences of your decisions? | |
| | Would you make different decisions and why? How did you like this group work? Did everyone respect given rules? Did you respect each other's opinions? . . . | |
| | − − − | |
| | Repeat the meaning of the concept DECISION | |
| | Give few examples from everyday life (**If** I write my homework **then** I can play. **If** it rains **then** I have to wear an umbrella or **else** I'll get wet.) | |
| **Annexes** | Game rules, question cards, score table and game board. | |
| **Examples and Game references** | Proprietary game - TRAFFIC | |

## Game rules

Three to seven players may play. Each player has one token.

The aim of the game is to revise the lessons about traffic from the subject of *Science* and to explain the concept DECISION.
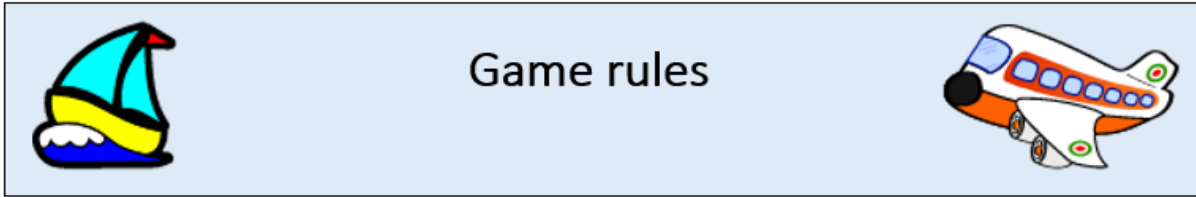
At the beginning of the game, each student roles a die.

The student with the highest number becomes the game leader. The leader gets a paper where she/he writes the players' names and keeps the scores. During the game, she/he is in charge for reading the questions from the cards. She/he also writes "C" for every correct answer or "I" for every incorrect answer as well as how many times the player stopped on one of the numbered fields (by putting the mark X for each stopping).

The aim is to reach the end of the path on the game board by stepping on as few fields as possible.

The player who rolled the smallest number starts the game. The player sitting on his right side plays next.

The game starting point is the picture of a traffic light ( 🚦 ).

Players move their pawns forward along the path by the number of fields indicated on the die. If the pawn ends on a field occupied by an opponent's pawn, the opponent's pawn is returned two fields backwards.


**Explanations of specific fields:**

 or  - Upon arrival in the fields with these traffic signs, the player has to roll an even number to continue the game. Otherwise, she/he pauses a round.

 - By coming to this field, the player takes one of the question cards and answers the question. If she/he answers correctly, she/he can roll the die and move forward according to the number indicated on the die. If her/his answer is incorrect, she/he needs to remain in that field until the next roll.

 or  - Upon arrival in the fields with these traffic signs, the player moves her/his pawn backwards for the number of fields that represents the smallest multiplier of the number indicated on the die.

 or  - By coming to the fields with these traffic signs, the player can move forward for two fields, if she/he explains exactly their meaning. Otherwise, she/he remains in that field until the next roll.

, , ,

 or  -

Upon arrival in these fields, the player has to decide whether to use a shortcut to reduce the number of fields that he will step on or resume the game without using the shortcut. If the player decides to use the shortcut, he needs to take two cards and answer the questions correctly. Otherwise, he needs to take the longer path.

A game winner is the one who has the most correct answers and first reaches the end of the path.

| | | |
|---|---|---|
| **What are the possible shapes of traffic signs?** | **Explain the difference between traffic lights for drivers and pedestrians.** | **What do the trains run on?** |
| **Which is the fastest vehicle?** | **What is the purpose of helmet and protectors while you are riding a bicycle?** | **Name three vehicles that drive on the road.** |
| **What do you call the place where we enter the train and come out of it?** | **How do you call the person who travels?** | **How do you call the person who drives a train?** |
| **What traffic signs did you notice next to your school?** | **Where will you check the time of departure and arrival of the bus?** | **What do we need to buy in order to travel?** |
| **What do traffic signs tell us?** | **Why do we need to know the meaning of the traffic signs?** | **Who checks the tickets on the bus?** |
| **Where can we check the time of departure and arrival of the bus at the bus station?** | **Does the railroad pass through your town?** | **Describe the difference between traveling by plane and traveling by car.** |
| **Can you travel from your town by plane?** | **Which types of ships do you distinguish?** | **Specify rules of polite behavior when traveling by boat.** |

| | | |
|---|---|---|
| How should we behave when traveling by bus? | Compare the passenger and freight train. Explain the difference. | Where are the passengers waiting for the departure or arrival of the train? |
| Who checks the tickets and takes care of passengers during the journey? | When can passengers get into the plane? | Describe the process of passenger and luggage control at the airport? |
| What is your role in traffic? | Which traffic signs do you need to respect? | What do you call a place where ships dock? |
| Where do we buy tickets? | Who flies a plane? | Ships are sailing: a) in the air b) on the water c) on the road |

## Annex: Score table

### Score table

- The game leader should enter C or I for each answer and mark X for each stopping on numbered fields.

| Player's name | | 1. | 2. | 3. | 4. | 5. | 6. | 7. | 8. | 9. | 10. | 11. | 12. | 13. | 14. | 15. | 16. | 17. | 18. | 19. | 20. | 21. | 22. | 23. | 24. | 25. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Answer: C / I | | | | | | | | | | | | | | | | | | | | | | | | | |
| | Stoppings: X | | | | | | | | | | | | | | | | | | | | | | | | | |
| | Answer: C / I | | | | | | | | | | | | | | | | | | | | | | | | | |
| | Stoppings: X | | | | | | | | | | | | | | | | | | | | | | | | | |
| | Answer: C / I | | | | | | | | | | | | | | | | | | | | | | | | | |
| | Stoppings: X | | | | | | | | | | | | | | | | | | | | | | | | | |
| | Answer: C / I | | | | | | | | | | | | | | | | | | | | | | | | | |
| | Stoppings: X | | | | | | | | | | | | | | | | | | | | | | | | | |
| | Answer: C / I | | | | | | | | | | | | | | | | | | | | | | | | | |
| | Stoppings: X | | | | | | | | | | | | | | | | | | | | | | | | | |

Annex: Game board
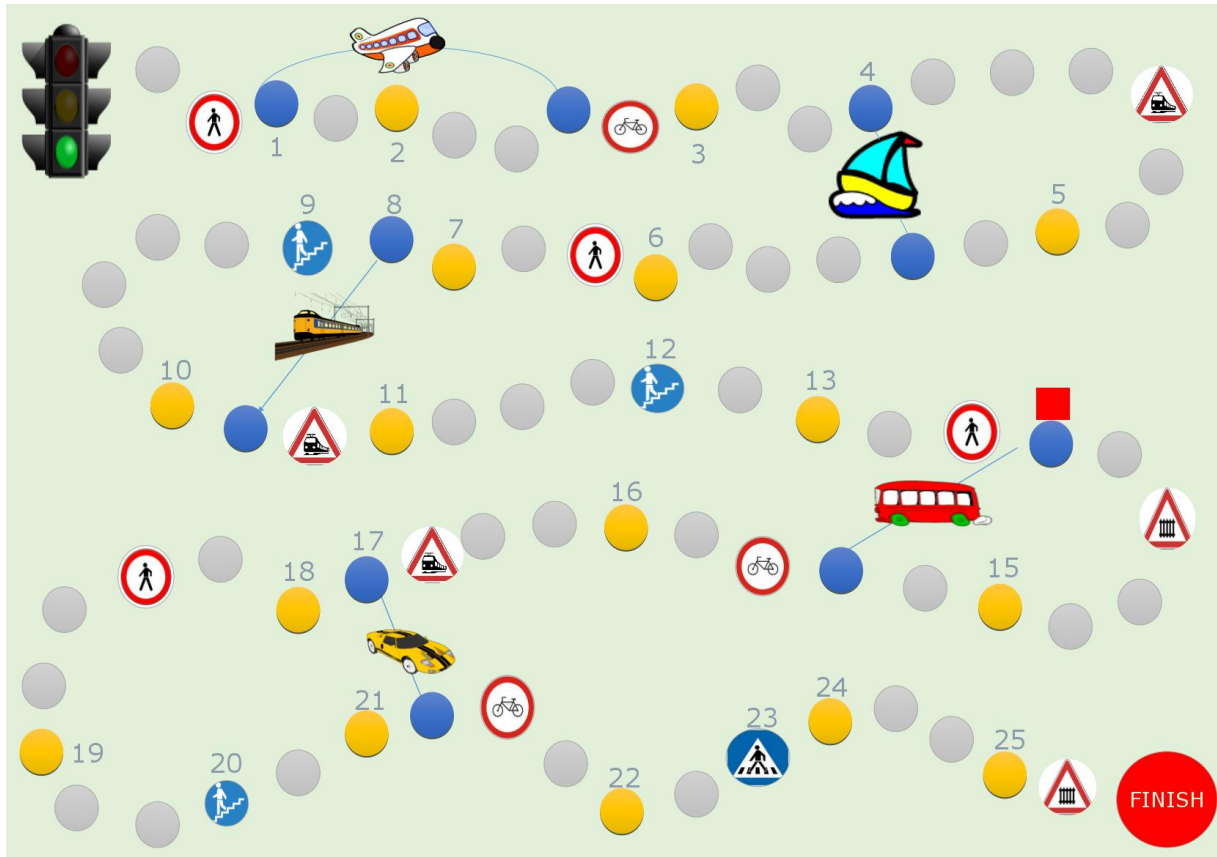
# Annex 8: Learning scenario "Addition and subtraction to 20"

*Author: Ana Cvitak*

| | |
|---|---|
| **Learning Scenario Title** | Addition and subtraction to 20 (repetition) |
| **Course/Grade** | Mathematics<br>1st grade of primary school |
| **Learning Outcomes** | **Learning outcomes focused on general subject:**<br>• Demonstrate the procedure of adding numbers to 20<br>• Demonstrate the procedure of subtracting numbers to 20<br>• Developing speed in addition and subtraction<br>• Compare and distinguish between correct and incorrect results<br><br>**Learning outcomes focused on algorithmic thinking:**<br>• Accept established, common rules of the game<br>• Specify the steps for moving left-right, up-down<br>• Explain the "algorithm"<br>• Describe and give solutions for achieving a certain goal |
| **Aim, Tasks and Short Description of Activities** | In the Mathematics class, the students will repeat and practice the addition and subtraction to 20 by playing the game "Math memory", solving the maze worksheet, and playing bingo. By playing games with chosen rules, the students repeat the lessons from Mathematics (addition and subtraction to 20).<br><br>Students will get acquainted with the concept of algorithm as a sequence of commands/rules that need to be performed to achieve the goals. |
| **Keywords** | Addition and subtraction to 20, left-right, up-down, algorithm, command |
| **Correlation and Interdisciplinarity** | Science (Orientation in space) |
| **Duration of Activities** | 45 minutes |
| **Learning and Teaching Strategy and Methods** | Game Based Learning - game<br>Dialogical method<br>Demonstration method<br>Problem solving method |
| **Teaching Forms** | Frontal teaching<br>Pair work<br>Individual work<br>Group work (all students) |
| **Tools** | - |
| **Resources/Materials for the Teacher** | Canva, Microsoft Word for preparing materials |

| Resources/Materials for the Students | Maze, bingo cardboards, Math memory game, colored pencils | |
|---|---|---|
| **Teaching Summary** | **Motivation-Introduction** | Duration |
| | Introductory conversation between teacher and students about Memory game and its rules, followed by giving the Math memory game cards to students. Students play the game in pairs. Teacher stresses out the importance of following the rules of the games. | 10 min |
| | Teacher introduces the concept of "algorithm" and explains that it represents a sequence of commands or rules that need to be performed to achieve the task. | |
| | **Implementation** | 25 min |
| | **1st activity:** Solving the maze worksheet (individual work) | |
| | The student's task is to help the boy find the right way to the ice cream. He/she has to paint the correct fields with a yellow pencil, and if he/she makes a mistake, he/she must return and start from the beginning. It is necessary to reach the goal as fast as possible in order to prevent ice cream melting. | |
| | After all students finish the game, we check all together the exact path, this time using the terms left-right, up-down. | |
| | **2nd activity:** Bingo (group work) | |
| | Each student receives a cardboard with numbers. The teacher draws the paper with the task out of the bag (e.g. 12-6, the correct answer is 6). If the student has number 6 on the cardboard, it has to be colored in red. If there are more than one numbers 6 on the cardboard, only one number can be colored. The winner is the student who first colors all the fields. | |
| | **Reflection and evaluation** | 10 min |
| | Discuss with the students about the game and its rules and repeat the meaning of the term algorithm. Students are encouraged to imagine a task that can be represented by the algorithm and we come to the conclusion that the algorithms are all around us, even crossing of the road itself represents an algorithm. They all list common rules for crossing the road. | |
| **Annexes** | Maze, Math memory game, bingo cardboards, bingo tasks | |
| **Examples and Game references** | Proprietary memory, maze, and bingo games | |

| CILJ | 19 | 3+16 | 3 | 17-14 | 17 | | | | |
| | | 16 | | | 10+7 | | | 18 | |
| | | 7+12 | 19 | 19-10 | 10 | 19-9 | 19 | 3+16 | |
| 19 | | 7 | | | | 19 | | 3 | |
| 7+11 | 8 | 16-9 | 16 | 6+10 | | 18+2 | 18 | 12-9 | |
| 7 | | 16 | | 6 | | 18 | | 12 | |
| 19-12 | 19 | 14+2 | | 18-12 | | 11+7 | 7 | 18-6 | |
| | | 14 | | 18 | | 11 | | 18 | |
| | 13 | 19-3 | 19 | 14+3 | 17 | 17-12 | 5 | 5+13 | 8 |
| | | | | START | | | | | |

| 2 | 6 | 10 | 10-2 |
| --- | --- | --- | --- |
| 1+1 | 8 | 9+1 | 5-5 |
| 5 | 2+3 | 0 | 3+3 |

Annex: Bingo cardboards

| 10 | | 4 | | | |
|---|---|---|---|---|---|
| 6 | 5 | 17 | 18 | 13 | 6 |
| | | | 19 | | |

| 10 | | | | | |
|---|---|---|---|---|---|
| 12 | 6 | 12 | 3 | 9 | 16 |
| | | 5 | | 17 | |

| 6 | 19 | | | | |
|---|---|---|---|---|---|
| | 14 | 14 | 3 | 10 | 4 |
| | | | 5 | | 18 |

| 12 |    | 1  |    |    |    |
|----|----|----|----|----|----|
| 6  | 5  | 17 | 15 | 13 | 2  |
|    |    |    | 19 |    |    |

| 2  |    |    |    |    |    |
|----|----|----|----|----|----|
| 5  | 6  | 7  | 3  | 1  | 16 |
|    |    | 5  |    | 17 |    |

| 2  | 19 |    |    |    |    |
|----|----|----|----|----|----|
|    | 14 | 1  | 3  | 10 | 11 |
|    |    |    | 5  |    | 18 |

| 11 |   | 4 |    |   |   |
|----|---|---|----|---|---|
| 2  | 5 | 17| 18 | 1 | 6 |
|    |   |   | 19 |   |   |

| 2  |   |    |   |    |    |
|----|---|----|---|----|----|
| 12 | 1 | 12 | 3 | 11 | 16 |
|    |   | 5  |   | 17 |    |

| 15 | 19 |    |   |    |    |
|----|----|----|---|----|----|
|    | 1  | 14 | 2 | 10 | 4  |
|    |    |    | 5 |    | 18 |

| | | | | | |
|---|---|---|---|---|---|
| 10 | | 4 | | | |
| 6 | 1 | 17 | 18 | 13 | 6 |
| | | | 19 | | |

| | | | | | |
|---|---|---|---|---|---|
| 11 | | | | | |
| 12 | 6 | 12 | 3 | 9 | 16 |
| | | 5 | | 17 | |

| | | | | | |
|---|---|---|---|---|---|
| 6 | 19 | | | | |
| | 14 | 14 | 3 | 11 | 4 |
| | | | 5 | | 18 |

| 10 |   | 4 |    |   |   |
|----|---|---|----|---|---|
| 1  | 5 | 17| 18 | 2 | 6 |
|    |   |   | 19 |   |   |

| 10 |   |    |   |    |    |
|----|---|----|---|----|----|
| 12 | 1 | 12 | 3 | 11 | 16 |
|    |   | 5  |   | 17 |    |

| 11 | 19 |    |   |   |    |
|----|----|----|---|---|----|
|    | 14 | 14 | 3 | 2 | 4  |
|    |    |    | 5 |   | 18 |

| 11 |   | 4  |    |   |   |
|----|---|----|----|---|---|
| 6  | 5 | 17 | 18 | 2 | 6 |
|    |   |    | 19 |   |   |

| 10 |   |    |   |    |    |
|----|---|----|---|----|----|
| 12 | 6 | 12 | 3 | 9  | 16 |
|    |   | 5  |   | 17 |    |

| 6  | 19 |    |   |    |    |
|----|----|----|---|----|----|
|    | 14 | 14 | 3 | 10 | 4  |
|    |    |    | 5 |    | 18 |

| | | |
|---|---|---|
| 17-10 | 17+2 | 8+4 |
| 16-10 | 11+8 | 5+7 |
| 13-7 | 7+12 | 8+6 |
| 12-6 | 9+7 | 7+7 |
| 11-5 | 16+3 | 19-7 |
| 19-16 | 13+6 | 19-3 |
| 18-13 | 8+10 | 8+5 |
| 19-14 | 14+4 | 9+9 |
| 17-13 | 16+1 | |
| 20-10 | 17-8 | |
| 13+4 | 17-11 | |

| Learning Scenario Title | Moving through the maze/Spatial orientation |
|---|---|
| Course/Grade | Science,  1st grade |
| Learning Outcomes | ***General learning outcomes***<br>• Determine the direction of movement: left-right, up-down and back and forth<br>• Moving in different directions in space (left-right, back and forth)<br>• Suggest the steps to navigate by the given path<br>• Suggest the steps to move from the starting to the ending position<br><br>***Specific LO oriented on algorithmic thinking***<br>• Interpret the term algorithm<br>• Determine a set to reach a predetermined goal |
| Aim, Tasks and Short Description of Activities | As part of the Science lesson, for repetition and practicing the concepts left and right, up and down and back and forth, the students will solve the worksheet with maze by placing the arrows to determine the default path. Students will lead each other from the initial position to the final position in the classroom (orientation on the paper and in space).<br>---<br>Students will get familiar with the term algorithm as a sequence of commands needed to accomplish the goal - arriving at the default location. |
| Keywords | Left-right, up-down, back-forth, algorithm, command |
| Correlation and Interdisciplinarity | Science, Physical education |
| Duration of Activities | 45 minutes |
| Learning and Teaching Strategy and Methods | Game-Based Learning<br><br>Dialog method<br><br>Problem-Solving method |
| Teaching Forms | Frontal teaching<br><br>Individual work<br><br>Group work by four students |
| Tools | none |
| Resources/Materials for the Teacher | Tools Canva and Microsoft Word for creating worksheets |
| Resources/Materials for the Students | Worksheet<br><br>Scissors<br><br>Pencil and notebook |

| Teaching summary | *Motivation – introduction to the activity* | Duration |
|---|---|---|
| | The teacher can stand next to the door of the classroom and ask the students for help to get to the blackboard. Students direct the teacher by specifying and counting the steps.<br><br>The teacher can write his "path" on the blackboard stating the steps (commands) he has made. Other possible ways of getting from the door to the blackboard can be pointed out in the conversation with students, which brings a conclusion that the same task can be solved in several ways. The term ALGORITHM is explained as a series of actions to be made in order to accomplish a particular task. | 10 minutes |
| | *Implementation*<br><br>1st activity: Solving the worksheet (individual work)<br><br>Students cut out the arrows from the worksheet and paste them into the maze to point out the path that will get a little bear to his mom. The student who first solved the task reads the steps in a way that assumes the role of a little bear and uses the words left-right and back-forth to read the steps. The next student reads the steps in a way that assumes the role of the observer and uses the words left-right and up-down.<br><br>2nd activity: Group game (4 students)<br><br>One student gives commands to another student (left-right and back-forth to pass the default path between desks and chairs. The task of a third student is to write commands as an algorithm with abbreviations L, R, B and F. All pupils of the group are counting the errors for movement and at the same time the fourth student is writing down those errors. All algorithms for passing through the same maze of different groups are presented on the blackboard and discussed in the classroom. | 25 minutes |
| | *Reflection (evaluation)*<br><br>Repeat the word *algorithm* and its meaning. Students cite the example of the simple tasks they perform daily (getting dressed, washing, preparing school bags ...) and devise an algorithm for solving that task. | 10 minutes |
| **Annexes** | Worksheet "Moving through the maze" | |
| **Examples and game references** | Happy cards: https://studio.code.org/s/course1/stage/1/puzzle/1 (30.10.2019.)<br>Artmedia mazes: https://www.artrea.com.hr/igre/Labirint2.html (30.10.2019.) | |

**Annex 10: Worksheet "Moving through the maze"**



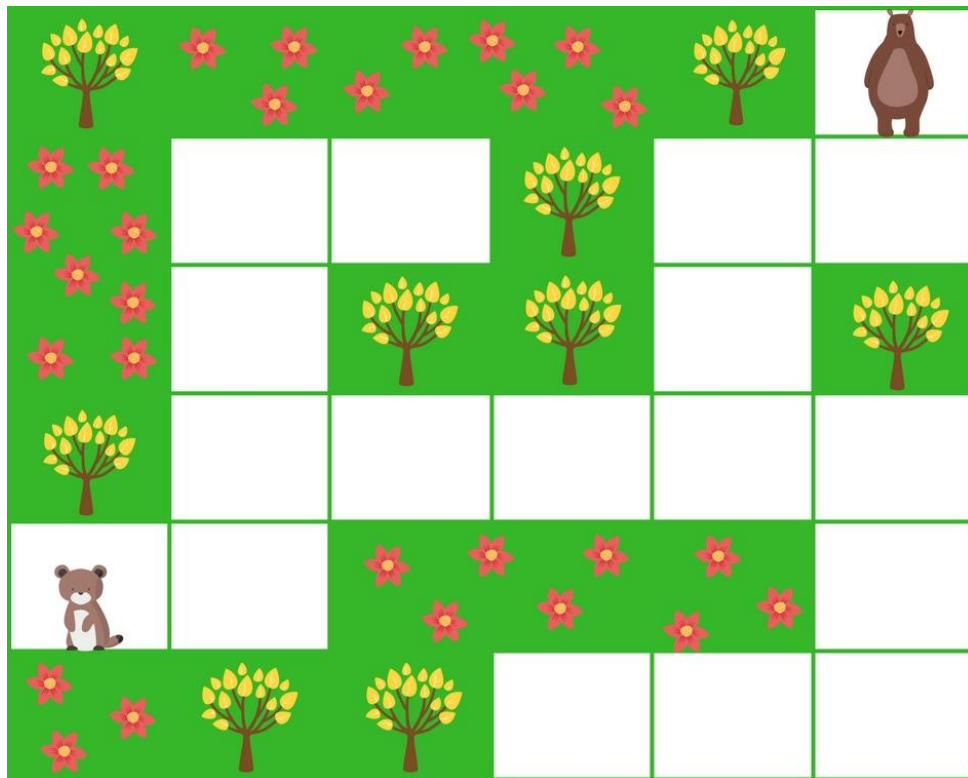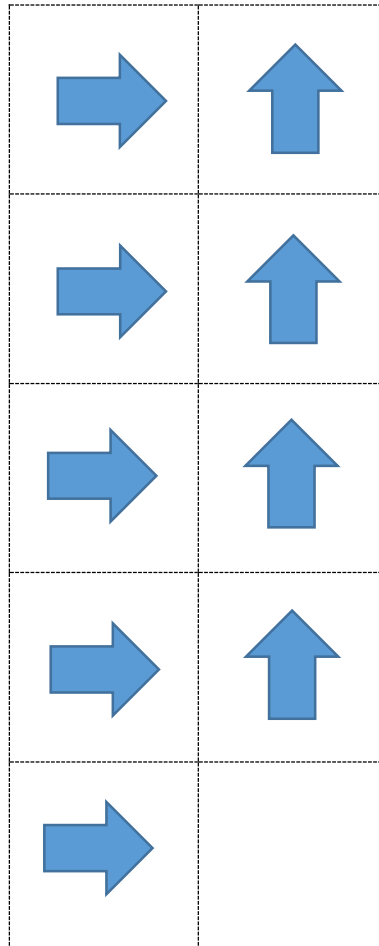Name and surname, grade

_____

## Walking through the maze

**Task** - Help the little bear to find the way to mother. Cut the arrows on the next page. Show with arrows steps that will take little bear through the forest to his mother and glue them below the maze.

# Annex 11: Learning scenario "Addition to 5"

*Author: Bojana Lanča*

| Learning Scenario Title | Addition to 5 |
|---|---|
| Course/Grade | Mathematics<br><br>1st grade of primary school |
| Learning Outcomes | **General learning outcomes:**<br>• Specify numbers 1 to 5 independently<br>• Connect number and number words<br>• Analyse and describe the image examples<br>• Adopt a notation for the addition<br>• Develop the abilities to compare, differentiate and conclude<br>• Add up numbers to 5<br><br>**Specific learning outcomes oriented on algorithmic thinking:**<br>• Search, find and extract relevant information<br>• Distinguish elements by attributes<br>• Compare and classify the numbers we add |
| Aim, Tasks and Short Description of Activities | AIM: learn to add up the numbers to 5<br><br>TASKS:<br>• Cognitive: learn the meaning of the sign +; adopt a notation for adding numbers; understand the concept of arithmetic operation; understand the concept of adding numbers.<br>• Psychomotor: write addition operations using mathematical signs; develop the ability to apply the acquired knowledge.<br>• Affective: develop the capacity for independent work, accuracy, consistency and precision; develop and stimulate curiosity.<br><br>SHORT DESCRIPTION OF ACTIVITIES:<br><br>Repeat numbers up to 5 and compare them through short Learning Apps computer games.<br><br>Using the Kahoot! quiz recognize the exact mathematical notation of tasks given in the mathematical story.<br><br>Add and subtract numbers up to 5 through the short Learning Apps computer games.<br><br>Explore the ways in which we can sum up multiple numbers in a way that the sum is equal to 5 (problem solving).<br><br>Test the knowledge with the interactive Wizer worksheet. |
| Keywords | Numbers 1, 2, 3, 4, 5, addition, equality. |
| Correlation and Interdisciplinarity | Croatian language (Little Red Riding Hood), Science (Orientation in space). |

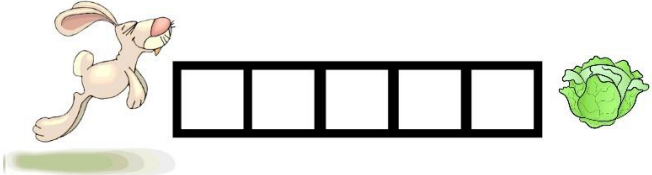| Duration of Activities | 90 minutes | |
|---|---|---|
| Learning and Teaching Strategy and Methods | Dialogical method<br>Demonstration method<br>Method of writing<br>Problem solving method<br>Game Based Learning | |
| Teaching Forms | Frontal teaching<br>Individual work<br>Group work | |
| Tools | Kahoot! tools and Kahoot! quiz, Wizer, LearningApps. | |
| Resources/materials for the Teacher | Kahoot! tools, Wizer, LearningApps. | |
| Resources/materials for the Students | Kahoot! quiz, Wizer, LearningApps. | |
| Teaching summary | **IMPLEMENTATION OF ACTIVITIES**<br><br>**1st activity: MOTIVATION - Two short computer games**<br>Students will repeat numbers up to 5, count them and compare them.<br><br>Example 1: Mathematical warming up<br>(https://learningapps.org/display?v=p82852wi318)<br>Example 2: Mathematical sequence<br>( https://learningapps.org/display?v=p3k5fr3uk18)<br><br><br>ANNOUNCEMENT OF OBJECTIVE: Announce that we will practice the addition of numbers to 5<br><br>**2nd activity: "Brainstorming!"**<br>Using brainstorming method students give examples of using addition in everyday life.<br><br>**3rd activity: "Kahoot!" Quiz**<br>Through five questions from everyday life (supported by appropriate pictures) students need to find the correct numerical expression of mathematical word problems.<br><br>QUESTION 1: There were three birds on the wire and two more landed on the wire. How many birds are now on the wire?<br><br>a. 1 + 2 = 3<br>b. 2 +3 =4<br>c. 3 + 1 =4<br>d. 3 + 2 = 5 | Duration<br><br><br>10 min<br><br><br><br><br><br><br>7 min<br><br><br><br>15 min |

QUESTION 2: There are three apples in the basket and one outside the basket. How many apples are there in total?

a. 1+ 3 = 5
b. 3 + 1 = 4
c. 2 + 1 = 3
d. 2 + 2 = 4

QUESTION 3: There is a pilot and three children in the plane. How many people are traveling by plane?

a.   2+ 2= 4
b.   3 +1 = 5
c.   4 +1 = 5
d.   1 + 3 = 4

QUESTION 4: Four cats are awake, and one is still sleeping. How many cats are there?

a.   4 + 1 = 5
b.   1 + 4 = 4
c.   2 + 3 = 5
d.   3 + 2 = 5

QUESTION 5: There are two pencils and two pens in the box. How many scribes are in the box?

a.   1 + 3 = 4
b.   4 +1 =5
c.   2 + 2 = 4
d.   3 + 1 = 4

**4th activity „Let's add up to 5"**
Using three games students practice the addition of numbers to 5.

Example 4: Color of the sum
(https://learningapps.org/display?v=pj7trtsia18)
Example 5: Adding up to 5
(https://learningapps.org/display?v=pyopr4nyj18)
Example 6: Mathematical puzzle
(https://learningapps.org/display?v=p4108eap318)

**5th activity „Problem-based learning"**
The students work in groups to solve the following task:
*Can we add various numbers to score 5? Explore.*
*If YES, write down all possible solutions that you have found.*
*If the answer is NO, explain why we cannot do this.*

20 min

20 min

| | Students write down solutions on the paper. Representatives of the group present their solutions. The first group presents all the results. Other groups check whether they have found the same solutions. The other two groups present only solutions not presented by the firsts group of students and so on. The teacher checks the accuracy of the solutions and add additional solutions if necessary. The teacher declares the winners - the group that that found the most solutions. | |
| | | |
| | **6th activity "WIZER worksheet"** Students test their knowledge using Wizer worksheet. Example 7: https://app.wizer.me/learn/55YALZ | 10 min |
| | **7th activity "A task that encourages algorithmic thinking"** The students should solve the following task: The rabbit wants the cabbage. The cabbage can be reached only by jumping two fields forward and one back. How many times a rabbit has to jump to reach the cabbage in the picture? | 8 min |
| **Annexes** | Learning scenario in LePlanner: https://beta.leplanner.net/#/scenario/5d728ae780a288cd3abb8783 Example 1 – Mathematical warming up: https://learningapps.org/display?v=p82852wi318 Example 2 – Mathematical sequence: https://learningapps.org/display?v=p3k5fr3uk18 Example 3 – Kahoot! Quiz: https://create.kahoot.it/details/zbrajanje-brojeva-do-5/9717c21c-8043-4f9e-879c-f8a1885f3bf2 Example 4 - Color of the sum: https://learningapps.org/display?v=pj7trtsia18 Example 5 – Adding up to 5: https://learningapps.org/display?v=pyopr4nyj18 Example 6 – Mathematical puzzle: https://learningapps.org/display?v=p4108eap318 Example 7 - Worksheet: https://app.wizer.me/learn/55YALZ | |
| **Examples and game references** | Kahoot! https://kahoot.com/ (15.12.2018.) Learning Apps https://learningapps.org/ (15.12.2018.) Wizer: https://app.wizer.me/ (15.12.2018.) | |

# Annex 12: Learning scenario "Months of the year"

*Author: Melita Stambulić*

| | |
|---|---|
| **Learning Scenario Title** | Months of the year |
| **Course/Grade** | Science<br><br>2$^{nd}$ grade of primary school |
| **Learning Outcomes** | **General learning outcomes:**<br>• Name months of the year<br>• Determinate the order of months of the year<br>• Explore the specific characteristics of each month of the year<br><br>**Specific learning outcomes oriented on algorithmic thinking:**<br>• Distinguish elements by attributes<br>• Search, find and connect the month with its characteristic<br>• Compare and classify months of the year |
| **Aim, Tasks and Short Description of Activities** | Aim is to revise and systematize the knowledge about the months of the year and to learn the importance of the months in everyday life.<br><br>Students will revise the main concepts about months of the year by using quiz, memory game and word association game on computer.<br><br>Problem-based learning will be used for exploring the specific characteristics of each month of the year (group work on a computer). |
| **Keywords** | Month, year, date |
| **Correlation and Interdisciplinarity** | Mathematics: numbers up to 100; roman numbers up to 100; ordinal numbers.<br><br>Art class<br><br>Science: seasons<br><br>Informatics |
| **Duration of Activities** | 45 minutes |
| **Learning and Teaching Strategy and Methods** | Game Based Learning<br>Dialogical method<br>Problem solving method<br>Method of reading and working with text<br>Method of writing |
| **Teaching Forms** | Frontal teaching<br>Individual work<br>Working in pairs<br>Group work |
| **Tools** | Kahoot! tools and Kahoot! quiz, Match the Memory, Microsoft PowerPoint, Internet browser |

| Resources/materials for the Teacher | Kahoot! tools, Match the Memory, Microsoft PowerPoint | |
|---|---|---|
| Resources/materials for the Students | Kahoot quiz, Match the Memory, Microsoft PowerPoint (association game), Internet browser | |
| Teaching Summary | **1. Motivation – introduction to the activity**<br><br>**Talk about months of the year:** students choose favorite month of the year and argue their choice, mention what they know about this month (the reason for the name, to which season it belongs, holiday or event in that month)<br><br>**Motivational game - association game**<br>(playing in groups of three students) | Duration<br><br>10 min |
| | **2. Main part of the activity**<br><br>Discussion for reviewing: year-month-number of days, names of months in the year, number of days in the month<br><br>Revising and systematizing the knowledge about the months of the year.<br><br>a) **Kahoot! quiz**<br>QUESTION 1: We call the first month of the year:<br><br>    a.   December<br>    b.   March<br>    c.   January<br>    d.   August<br><br>QUESTION 2:  February has:<br><br>    a.   30 days<br>    b.   31 days<br>    c.   28 days<br>    d.   28 or 29 days<br><br>QUESTION 3: The month in which autumn starts is:<br><br>    a.   September<br>    b.   October<br>    c.   November<br>    d.   December<br><br>QUESTION 4: We celebrate the New Year in:<br><br>    a.   December<br>    b.   February<br>    c.   November<br>    d.   January<br><br>QUESTION 5: The school year starts in:<br><br>    a.   July<br>    b.   April<br>    c.   September<br>    d.   June | 25 min |

| | QUESTION 6: The year ends in:<br><br>    a.  January<br>    b.  August<br>    c.  October<br>    d.  December<br><br>b) **Memory game** (Match the Memory) – students play in pairs<br><br>Match the month of the year with the date:<br>         January – 1.1.<br>         February – 28.2.<br>         March – 15.3.<br>         April – 20.4.<br>         May – 30.5.<br>         June – 25.6.<br>         July – 31.7.<br>         August – 15.8.<br>         September - 5.9.<br>         October - 8.10.<br>         November - 1.11.<br>         December - 31.12.<br><br>c) **Problem based learning**<br><br>Students are divided into groups of 3. Each group draws a paper with the name of one month of the year. The task is to enter the name into Internet search engine and to choose one of the pictures among the results. The students should explain their selection: why exactly this picture presents main characteristics of the month. | |
| **3. Reflection and evaluation**<br><br>Each student receives a "paper candle" on which has to write the date of his/her birthday.<br><br>Students attach their candle to a picture of a large 12-layer cake. Layers are named according to the months of the year and a student attaches the candle to the layer with the name of the month in which he/she celebrates birthday.<br><br>After attaching the candle, students are forming groups by month in which they celebrate birthday.<br><br>The students repeat names of months in the year in correct order.<br><br>Discussion: In which month most/least students celebrate their birthday. | 10 minutes |

| Annexes | Learning scenario in LePlanner: |
|---|---|
| | https://beta.leplanner.net/#/scenario/5d72907980a288cd3abb87c1 |
| | Association game |
| | Kahoot! quiz: https://play.kahoot.it/#/k/d89977ac-f463-4a91-af3e-1eed202b0a09 |
| | Match the Memory game: https://matchthememory.com/mjeseciugodinimelita |
| **Examples and game references** | Kahoot! https://kahoot.com/ (15.12.2018.) |
| | Match the memory https://matchthememory.com (15.12.2018.) |

## Annex: Association game

| A1 | B1 | C 1 | D 1 |
|----|----|----|----|
| A2 | B2 | C 2 | D 2 |
| A3 | B3 | C 3 | D 3 |
| A4 | B4 | C 4 | D 4 |
| COLUMN A | COLUMN B | COLUMN C | COLUMN D |

### FINAL SOLUTION

| | | | |
|----|----|----|----|
| CUTTING WOOD | SCHOOL STARTS | LINDEN BLOSSOMS | SPRING |
| WINTER BREAK | FIRST DAY OF AUTUMN | FIRST DAY OF SUMMER | EASTER |
| NEW YEAR'S DAY | PICKING APPLES, PLUMS | SCHOOL ENDS | FRUIT TREE BLOSSOMS |
| 1ST MONTH | 9TH MONTH | SUMMER BREAK | SPRING BREAK |
| JANUARY | SEPTEMBER | JUNE | APRIL |

### MONTHS OF THE YEAR

# Annex 13: Learning scenario "Spatial orientation"

*Author: Kristina Ujčić-Čučak*

| Learning Scenario Title | Spatial orientation |
|---|---|
| Course/Grade | Science<br><br>3rd grade of primary school |
| Learning Outcomes | **General Learning Outcomes:**<br>• Determine the cardinal and intermediate directions and know how to note them with abbreviations<br>• Name the cardinal directions where sun rises and fall and therefore manage the orientation<br>• Determine viewpoint and horizon, orientation by compass, sun or other signs on the ground<br>• Manage the topographic map or town map<br>• Distinguish the meaning of colour hues on the map<br><br>**Specific Learning Outcomes oriented on Algorithmic Thinking:**<br>• According to the adopted algorithm, create a map to find the hidden treasure |
| Aim, Tasks and Short Description of Activities | Aim: revise and systematize the processed teaching material (orientation in space)<br><br>Tasks:<br>a) Identify the viewpoint, the horizon, the plan, the map, to associate the image and the word, to write abbreviations of the cardinal and intermediate directions, to determine the cardinal points from the current position of the sun, to orient by the compass, to determine the meaning of colour on the map and to describe the relief, explain the legend on the map, manage the map and plan and find the hidden treasure, according to the algorithm create a treasure map.<br>b) To practice spatial orientation, develop logical thinking, conclusion, memory<br>c) To promote conscientiousness in work, to develop patience, persistence and tidiness in performing tasks, to develop Science.<br>LIST OF ACTIVITIES<br><br>1. Memory game<br>2. Review with Kahoot<br>3. Spatial orientation – treasure map (group work)<br>4. Creating a map (work in pair)<br>5. Worksheet Wizer |
| Keywords | Cardinal and intermediate directions, viewpoint and horizon, town map, topographic map |

| Correlation and Interdisciplinarity | Art class – colour hues | |
|---|---|---|
| **Duration of Activities** | 90 minutes | |
| **Learning and Teaching Strategy and Methods** | Dialogical method<br>Demonstration method<br>Problem solving method<br>Game Based learning | |
| **Teaching Forms** | Individual work, frontal teaching, work in pairs, group work | |
| **Tools** | Kahoot! tools and Kahoot! quiz, Wizer, Learning Apps, Match the memory | |
| **Resources/materials for the Teacher** | Kahoot! tools, Match the memory, Wizer, LearningApps for preparing quiz, memory game and interactive worksheets | |
| **Resources/materials for the Students** | Kahoot! quiz, Match the memory, Wizer, LearningApps for solving quiz, memory game and interactive worksheets on iPad | |
| **Teaching Summary** | **IMPLEMENTATION OF ACTIVITIES** | |
| | **1. INTRODUCTORY PART**<br><br>A game of Hangman (frontal work)<br><br>Using the game, reach the keywords and topics of today's class (orientation). Repeat what it means to be oriented, ie. spatial orientation. | 5 min |
| | **2. MAIN PART**<br><br>**- Memory (individual work)**<br><br>Visualize the basic concepts: viewpoint, horizon, map, plan. | 5 min |
| | **- Kahoot quiz (individually solve the quiz, frontal analysis of tasks)**<br><br>Revise the processed content. | 15 min |
| | **- Spatial orientation (work in pairs)**<br><br>Select the viewpoint.<br><br>Determine the cardinal and intermediate directions on school playground using the Sun.<br><br>Orient by the compass, follow the map with instructions, find the hidden treasure.<br><br>Analysis and evaluation of activities.<br><br>**- Making a treasure map (group work)** | 20 min |

| | According to the algorithm that followed, create a map that will lead the other group to the hidden object. | 30 min |
|---|---|---|
| | **3. FINAL PART** | |
| | **- Wizer worksheet** | |
| | Solve worksheet for self-assessment. | 10 min |
| | Set homework - determine the cardinal and intermediate directions in your bedroom / living room. Draw the map of that room. | 5 min |
| **Annexes** | Learning scenario in LePlanner:<br>https://beta.leplanner.net/#/scenario/5d7281a480a288cd3abb876e<br><br>GAME OF HANGMAN<br>https://learningapps.org/display?v=pxbx2d8o518<br><br>STAPLE<br>https://matchthememory.com/orijentacijakika<br><br>TREASURE HUNT<br>https://learningapps.org/display?v=p05tz96fn18<br><br>Kahoot!<br>https://create.kahoot.it/create#/edit/0196a25f-66c4-4973-8712-13bdcfeafdc6/done<br><br>Wizer<br>https://app.wizer.me/learn/OY2KVJ | |
| **Examples and game references** | Learning Apps https://learningapps.org (15.12.2018.)<br><br>Match the memory https://matchthememory.com (15.12.2018.)<br><br>Kahoot! https://create.kahoot.it (15.12.2018.)<br><br>Wizer https://app.wizer.me  (15.12.2018.) | |

# Annex 14: Learning scenario "Nutrition"

*Author: Tašana Bobanović*

| | |
|---|---|
| **Learning Scenario Title** | Nutrition |
| **Course/ Grade** | Science<br><br>2nd grade of elementary school |
| **Learning Outcomes** | **General learning outcomes:**<br><br>• List the foods important to our health<br>• Name the daily meals<br>• Explain the relationship of diverse and regular diet with health<br>• Describe decent behaviour at the table<br>• Use the cutlery properly<br><br>**Specific learning outcomes oriented on algorithmic thinking:**<br><br>• Identify and apply basic programming concepts when designing a game in Scratch (algorithm, sequence, condition, loop, variable)<br>• Identify different as well as the shortest solution to achieve a specific goal and recognize<br>• Solve simple logic tasks |
| **Aim, Tasks and Short Description of Activities** | Students will visit food market and observe groceries that can be bought there. Students will learn about food that should be regular in the diet, the names of the main meals, and how to behave at the table during the meal. They will design a computer game for identifying healthy foods. |
| **Keywords** | Nutrition, groceries, meals, game |
| **Correlation and Interdisciplinarity** | Croatian, Art, Informatics |
| **Duration of Activities** | 5 school hours (5x45 minutes) |
| **Learning and Teaching Strategy and Methods** | Oral presentation<br>Dialogical method<br>Problem solving method<br>Method of reading and working with text<br>Method of writing<br>Game Based Learning |
| **Teaching Forms** | Frontal teaching<br>Individual work<br>Group work |
| **Tools** | Internet browser, Scratch |
| **Resources/materials for the Teacher** | Photos, chalk and board, textbook, Internet browser, Scratch |

| Resources/materials for the Students | Prepared materials, notebook, textbook, Internet browser, Scratch | |
|---|---|---|
| **Teaching Summary** | Motivation-Introduction | Duration |
| | The teacher will show food drawings to the students. They will classify shown foods into two groups: foods that should be regular in the diet and foods that should be eaten moderately or avoided. The teacher will show the drawings in the particular order: three types of food that should be regular in the diet, and one that we should eat moderately or avoided. Students will have to determine by themselves why the teacher is showing the foods in this order. | 15 min |
| | Implementation | |
| | 1. A few days before the activity, the teacher and students will visit the town food market. Students will receive the research question: What can we do at the market? | 60 min |
| | They will carefully look at all the part of the market, indoor and outdoor, and observe groceries that can be bought at the market. Students will keep their own notes to solve the following tasks: | |
| | a) Observe the parts of the market and list them. b) List the groceries that can be purchased outdoors. c) List the groceries that can be purchased in the first pavilion. d) List the groceries that can be purchased in the second pavilion. e) List the groceries that can be purchased in the third pavilion. f) Draw the space of the market place. | 15 min |
| | 2. After motivation, I will ask the students to remember what they saw at the town food market. Everything they remember will be written on a whiteboard. The areas of the market will be connected to the groceries. | |
| | Student will use the textbook and with the help of teacher sort out the words related to proper nutrition. With these words students will construct sentences. For example: | |
| | • Proper nutrition is important for health.<br>• Proper nutrition should include a variety of foods.<br>• Oily, salty and sweet foods should be eaten moderately.<br>• Food is needed to grow and maintain health. | 30 min |
| | Then, the main meals and how people should behave at the table will be discussed. | |

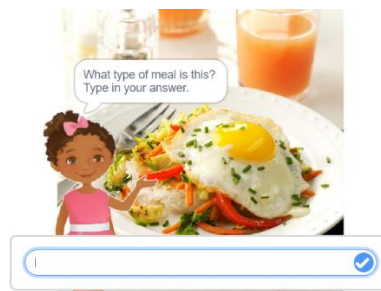| | 3. The teacher will guide students through the process of designing a digital story with game elements. First, the teacher will show several games created in Scratch: https://scratch.mit.edu/projects/281378543/ https://scratch.mit.edu/projects/281460031/ https://scratch.mit.edu/projects/281418234/ Then, the teacher will announce that the student will design a game with several logical mini-games. The student will choose the main character and the part of the market where the mini-games will be played. Students should also design the flow of the game and agree on the scoring method as well as the prize for the player who achieves the goal of the game. | 60 min |
|---|---|---|
| | Reflection and evaluation After university students create the game in Scratch, the students will play and discuss whether they like the game. | 45 min |
| **Annexes** | Learning scenario in LePlanner: https://beta.leplanner.net/#/scenario/5d71e0bd80a288cd3abb86ad Story/game scenario "Let's eat healthy!" | |
| **Examples and Game References** | Developed Scratch game – Let's eat healthy!: https://scratch.mit.edu/projects/325739167/ (30.7.2019.) Scratch – A story about cleanliness and health: https://scratch.mit.edu/projects/281378543/ (30.7.2019.) Scratch game – Red clocks: https://scratch.mit.edu/projects/281460031/ (30.7.2019.) Scratch game – Live and inanimate nature: https://scratch.mit.edu/projects/281418234/ (30.7.2019.) | |

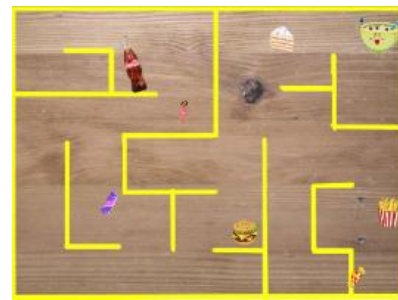| Title of the game | Let's eat healthy! |
|---|---|
| Type | Scratch story with game elements |
| Course/ Grade | Science<br>2nd grade of elementary school |
| Learning outcomes | • Get to know the groceries that are important to our health<br>• Explain the relationship of diverse and regular diet with health<br>• Play a simple game<br>• Choose the right solution<br>• Solve simple logic tasks<br>• Recognize basic programming concepts |
| Goal of the game | The goal of the game is to follow the instructions. With the help of instructions, students will solve tasks and learn about healthy eating. |
| Characters and their roles | **Tašana** (main character)<br><br>Tašana is a little girl who appears throughout the game. Tašana gives different instructions during the game. Based on these instructions, the student accomplishes tasks in order to adopt new content and reach the goal, the end of the game.<br><br>**Grandma Sandra** (supporting character)<br><br>Grandma is a character who appears in the game to give directions. Grandmother represents a worker at the market. Tašana arrives to her food stall to pick healthy groceries. |
| Description of the game flow | Pressing the *s* key starts the game. Tašana first calls a player (a student) to help her buy healthy foods. Tašana comes to the market where grandmother appears and gives directions for the first mini-game. The game is started by clicking the key *1*. The player should use left and right keys to move and collect 20 healthy groceries in the basket. The player has 30 seconds to collect groceries. If the player does not collect enough healthy groceries, the game starts over. The next game is started using the key *2*. The player should lead Tašana through the maze to find cereals. After successfully passing the maze, the girl goes home. On her way, she comes across a wall. To see the next task, the player should press key *3*. The task is to arrange the words of a phrase related to healthy diet in the correct order. The player should also write the name of the meal shown on the photo. If the player answers correctly, Tašana is ready for lunch. Key 4 starts the final mini-game where the player should set the table. |
| List of scenes / backgrounds | 1. Home<br>2. Market (market1, market2, market3, market4, market5)<br>3. Street<br>4. Wall<br>5. Kitchen<br>6. Breakfast<br>7. Table (table1, table2)<br>8. Set the table<br>9. Final |

| Logical mini-games within the story | 1. **Collect healthy groceries** |
| --- | --- |
| | The player moves left and right using the arrows on the keyboard to collect healthy groceries to the basket. The player should avoid unhealthy foods. |
| | 2. **The maze** |
| | Using the arrows on the keyboard (up, down, left, right) the player moves through the maze and avoids obstacles and unhealthy foods to reach the cereals. |
| | 3. **The wall** |
| | The player should arrange the words of a phrase *Healthy food – healthy life!* in the correct order. |
| | 4. **Setting the table** |
| | There is a spoon, fork, knife and dessert spoon on the table. The player's task is to properly set the table for lunch. |
| **End of the game** | After the player completes all the tasks, the game ends. To play again, the player should press *s* key. |

## Screenshots from the game

# Annex 15: Learning scenario "The fruits of the seasons"

*Author: Mate Verović*

| | |
|---|---|
| **Learning Scenario Title** | The fruits of the seasons |
| **Course/Grade** | Science<br><br>1st grade of primary school |
| **Learning Outcomes** | **General learning outcomes:**<br><br>• Recognize the characteristics of particular seasons.<br>• Explore the specifics of the seasons and seasonal fruits.<br>• Design a game for repeating the aforementioned contents (distinguish the seasons by observation, describe the weather conditions of all seasons, associate appropriate clothes with specific seasons, identify and name seasonal fruits and vegetables according to seasons).<br><br>**Specific Learning outcomes oriented to algorithmic thinking:**<br><br>• Search, find, and extract relevant information.<br>• Summarize and extract elements by attributes.<br>• Compare and classify seasons and fruits.<br>• Identify and apply basic programming concepts when designing a game in Scratch (algorithm, series of commands, condition, loop, variable). |
| **Aim, Tasks and Short Description of Activities** | Repeat and practice recognizing and distinguishing the characteristics of the seasons.<br><br>Promote healthy eating habits.<br><br>For each season, examine seasonal fruits specific to our climate.<br><br>Create a thematic poster with fruits for each season.<br><br>Participate in the design of a story (scenes, flow, logical tasks) that will encourage the identification of specific characteristics of each season.<br><br>Play the game and evaluate the whole process. |
| **Keywords** | seasons, autumn, winter, spring, summer, characteristics, seasonal fruits, healthy eating, algorithm of commands, game |
| **Correlation and Interdisciplinarity** | Croatian Language, Art, Informatics, Mathematics |
| **Duration of Activities** | During May 2019 (230 min) |
| **Learning and Teaching Strategy and Methods** | Active learning method, collaborative learning, problem solving, dialog method, viewing method, demonstration method, research method of learning, computer games |
| **Teaching Forms** | Individual, frontal, group work, work in pairs |
| **Tools** | Scratch, Internet browser |

| Resources/materials for teachers | Scratch, Internet browser, examples of computer games in Scratch | |
|---|---|---|
| Resources/materials for students) | Scratch, Internet Browser, posters, felt-tip pens, tempera, coloured thread/wool, activity captions, photos of smileys | |
| Teaching summary | MOTIVATION<br><br>Game of association. | Duration |

| SNOW | CHANGEABLE | FRUIT | HOT |
|---|---|---|---|
| ICE | SWALLOW | FOG | HOLIDAYS |
| COLD | PRIMROSE | RAIN | BREAK |
| CHRISTMAS | EASTER | PICKING GRAPE | SUN |
| **WINTER** | **SPRING** | **AUTUMN** | **SUMMER** |
| **SEASONS** | | | |

**20 min**

Students watch an animated video "Four Seasons" on Youtube

https://www.youtube.com/watch?v=n52naW_VXBo&t=5s

Short commenting on the video.


Students solve the puzzles:

No paint, no brush, but trees shine in colours! (autumn)

No teeth, no hands, but it bites! (winter)

Two housewives each year cover the table: one with a green tablecloth, the other with a white tablecloth. (spring and winter)

The sun is hot; everyone is running in the shade! (summer)


Teacher asks the following questions:

Do you know that there are parts of the planet where the season is always the same?

What do you think, what problem do people who live there have?

What kind of clothes and shoes do they need?

Do they have enough food?

Do they grow fruits and vegetables?

Have you heard of refugees and migrants?

| | There are people who leave their homes and go with their families to other parts of the world because the soil has dried up and vegetables and fruits cannot be grown. Where people are hungry, wars often break out, which is another reason why they leave their homes. | |
| --- | --- | --- |
| | Many people and children have gone through our country in recent years in search of a better life. Some of them stayed here with us. | |
| | One boy/girl came from Africa and stayed in Croatia. He/she comes from a place where there is a shortage of water and food and it is constantly very hot. He/she wants to know what life is like here. He/she heard that 4 seasons alternate during the year, and that various fruits and vegetables grow here. He/she is interested in the specificities of each season and their fruits. He/she wants to stay healthy by eating only seasonal fruits. | |
| | Would you like to help him/her describe what the seasons look like in our country and what fruits and vegetables are ripening in them? | |
| | Implementation | |
| | ACTIVITY 1 (research assignment) | |
| | Project assignment (division and definition of assignments for group work: 6 students in a group, 4 groups, each group gets a specific part of a project assignment). The specificities of the seasons and their seasonal fruits will be explored partly at school, with the supervision of the teacher, but mostly at home with the supervision of the family members. | 45 min |
| | *1. group:* AUTUMN – characteristics and seasonal fruits<br>*2. group:* WINTER – characteristics and seasonal fruits<br>*3. group:* SPRING – characteristics and seasonal fruits<br>*4. group:* SUMMER – characteristics and seasonal fruits | |
| | Also, each group will determine the gender and the name of the child from the story who will be helped with this research. | |
| | ACTIVITY 2 | |
| | Together with the students, I check the correctness of the collected data. Each group makes their own poster with the theme of the given season and its seasonal fruits that they have explored. | 30 min |
| | ACTIVITY 3 | |
| | Two students from each group briefly present the poster, in the way that they mention the main characteristics of the season and list several seasonal fruits. During the | 15 min |

presentation, one of the students addresses the named character from the story who is played by another student.

ACTIVITY 4

Do you think your character remembers everything you showed him/her from the poster?

What do you think about making him/her a computer game that will help him/her to remember faster and better everything you showed him/her and said to him/her, and at the same time have fun? I show the examples of similar computer games:

https://scratch.mit.edu/projects/3028073/

https://scratch.mit.edu/projects/96101619/

Students in groups should, for their season:

1. Design the scene according to the season.
2. Choose which outfit the main character could wear.
2. Describe the game/event within the given season.
3. Define the moves of the main character.
3. Come up with what he is doing, saying.
4. Describe the main character's tasks.
5. Define the way the points are collected.
6. Determine the ultimate goal of the game.
7. Determine when the game is over.


The teacher gives a possible example.

E.g. SUMMER - evident summer scene (beach, sea...)

The main character should be dressed according to the season in the background, with the summer clothes that are offered among clothes for all four seasons, at a given time. If the main character is dressed properly, he/she can start collecting fruits/points typical of summertime (fruits typical of other times are also offered). If the main character fails to dress properly within the given time, the further course of the game cannot be accessed and it is returned to the beginning.

For example, in the summer, the main character will need to be dressed in a swimsuit in order to enter the sea/lake and collect fruits while swimming. The fruits that appear are always the same, and they need to be recognized and picked up, but only those associated with the season/background/scene in which the main character currently is, otherwise the points are deducted. There can be 12 fruits, three of which will belong to each season (e.g. watermelon, apricot, melon, pumpkin, pomegranate, olive, lemon, orange, kiwi, cherry, radish, young onion...)

45 min

| | | |
|---|---|---|
| | When finished with designing, each group presents their answers to those present. | |
| | ACTIVITY 5 | |
| | In this activity, the students, with the help of the teacher, define and write down the final sequence of the game with all the details, tasks, conditions… Also, by voting, they decide how many points will bear the right and wrong choice of fruits. They also decide how many points will be needed to move to the next level/next season and at what time. Finally, they agree on which goal/final outcome will be chosen from the 4 proposed. | 20 min |
| | ACTIVITY 6 | |
| | The game is created by university students in collaboration with the 6th grade student and the teacher, and students are involved in the creation process by thinking through and suggesting possible solutions. The teacher and the senior student encourage students to cooperate. The students then play the game and determine its name by voting. | 45 min |
| | Reflection on the performed activity (evaluation) | |
| | (Reflection and evaluation) | |
| | 6 signs (side by side) are placed on the panel, i.e. 6 names of the completed stages which the students participated in: | |
| | 1. Research work<br>2. Creating a thematic poster<br>3. Presentation of the poster, i.e. conversation with the main character<br>4. Designing a game<br>5. Participation in the making of the game<br>6. Playing the computer game | 10 min |
| | Under each sign, there are three smileys, one smiling, the other serious and the third dissatisfied. Each student will get approximately 2 m of thread or thin coloured wool. The evaluation is done in such a way that each thread/wool will be marked with one smiley face. The wool/thread is wrapped around the pin once and continues to "travel" to the next smiley face. The amount of wool/thread on certain smileys will clearly reflect the students' opinion on the activities carried out. | |
| **Annexes** | Learning scenario in LePlanner:<br><br>https://beta.leplanner.net/#/scenario/5d6e4aa080a288cd3abb8640<br><br>Story/game scenario "Seasons" | |

| **Examples and game references** | Developed Scratch game – Seasons: https://scratch.mit.edu/projects/326888540/ (30.7.2019.) |
|---|---|
| | 4 Seasons: https://www.youtube.com/watch?v=n52naW_VXBo&t=5s (30.7.2019.) |
| | Scratch game – Stegocrunch: https://scratch.mit.edu/projects/3028073/ (30.7.2019.) |
| | Scratch game – Fruit Adventures: Part 1: https://scratch.mit.edu/projects/96101619/ (30.7.2019.) |

## Annex 16: Game/story scenario "Seasons"

| | |
|---|---|
| **Title of the game** | Seasons |
| **Type** | Scratch story with game elements |
| **Course/Grade** | Science: Seasons / Health<br><br>1st grade of primary school |
| **Learning outcomes** | **Learning outcomes focused on general subjects**<br><br>• Recognize the seasonal fruits of particular seasons<br>• Associate appropriate clothes with specific seasons<br><br>**Learning outcomes focused on algorithmic thinking**<br><br>• Search, find, and extract relevant information |
| **Goal of the game** | Dress the main character in season-appropriate clothing to eventually harvest the fruits characteristic of that season. |
| **Characters and their role** | Mia – the main character<br><br>Family (mom, dad, 2 sisters, 1 brother) - supporting characters |
| **Description of the game flow** | The main character introduces the player into the story. Little girl Mia comes from Africa to Croatia in search of a better life. The goal is to teach Mia all about the seasons specific to the Croatian climate. For each season, it is necessary to first dress appropriately Mia, which is also a condition for continuing the game. Successful dressing is followed by the second part of the game, in which fruits specific to a particular season are collected. In that way the main character goes through all four seasons. By collecting the correct fruit, the player wins 1 point, while by making the wrong choice, he loses 1 point. Accordingly, by collecting seasonal fruits in all seasons, the player can collect a total of 36 points, out of which a minimum of 20 points is required for successful completion of the game. |
| **List of scenes/backgrounds** | 1. Park - an introduction to the game<br>2. Africa<br>3. Summer - Dubrovnik, beach, sea<br>4. Laundry rope - choose summer clothes<br>5. Sailboat<br>6. Summer - beach - selection of summer fruits<br>7. Tree (displaying 4 seasons) - entry of the season following the summer<br>8. Autumn – forest<br>9. Laundry rope - choose autumn clothes<br>10. Autumn - forest - selection of autumn fruits<br>11. Tree (displaying 4 seasons) - entry of the season following the autumn<br>12. Winter - mountains, snow, cottage<br>13. Laundry rope - choose winter clothes<br>14. Winter – selection of winter fruits<br>15. Tree (displaying 4 seasons) - entry of the season following the winter |

| | 16. Spring – Meadow<br>17. Laundry rope - choose spring clothes<br>18. Spring – selection of spring fruits<br>19. Promenade - end, display of points won, arrival of Mia's family |
|---|---|
| **Logical mini-games within the story** | Recognizing the characteristics of the seasons.<br><br>**The first part of the game for each season:** Choosing the right clothes for the main character according to the current season. Condition to continue the game - collecting points. Minimum required for each season:<br><br>• Summer: 4 points<br>• Autumn: 3 points<br>• Winter: 4 points<br>• Spring: 3 points<br>**The second part of the game for each season:** Collecting fruits specific for specified season. By collecting fruits, a maximum of 9 points can be collected in each season. |
| **End of the game** | If all four levels are successfully played and the minimum number of points (20 points) is collected, we get to know the whole family of the main character.<br><br>If the player does not collect enough points, Mia instructs him/her to repeat the game from the beginning. |

## Screenshots from the game
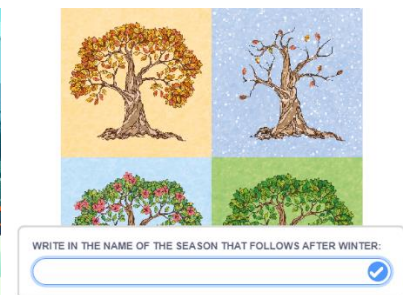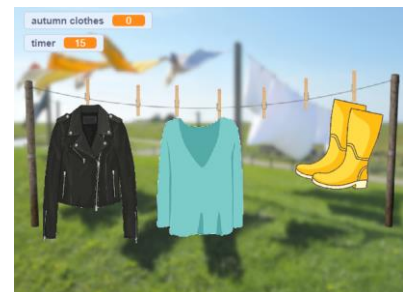
# Annex 17: Learning scenario "Playing and calculating up to 20"

*Author: Blaženka Bajić*

| | |
|---|---|
| **Learning Scenario Title** | Playing and calculating up to 20 |
| **Course/Grade** | Mathematics<br><br>1st grade of primary school |
| **Learning Outcomes** | **Learning outcomes focused on general subject:**<br>• Add numbers up to 20<br>• Subtract numbers up to 20<br>• Write down the calculus with a mathematical notation<br>• Name the members in computational operations<br>• Apply the commutative property<br><br>**Learning outcomes focused on algorithmic thinking:**<br>• Recognize the possibility of using the micro: bit for game<br>• Identify and apply basic programming concepts when designing a game in Scratch (algorithm, sequence, condition, loop, variable) |
| **Aim, Tasks and Short Description of Activities** | Apply the computational actions of summing and subtracting up to 20 in the research learning to design the numerical expressions and word-given tasks. Design and write down a computer game to practice adding and subtracting numbers up to 20. |
| **Keywords** | Addition and subtraction to 20, addends, sum, changing the order of the addends in a sum. |
| **Correlation and Interdisciplinarity** | Music – Elements of musical creativity: Tone painting<br>Croatian language – Linguistic expression: Asking questions and giving answers<br>Art – Flat design painting: Color - color names, basic and derived colors, color tones.<br>Mathematics – Shapes in Space, Numbers 11 to 20<br>Science – Spatial orientation |
| **Duration of Activities** | 90 minutes, during May |
| **Learning and Teaching Strategy and Methods** | Dialogue method<br>Oral presentation method<br>Method of reading and working on the text<br>Demonstration method<br>Writing method<br>Game based method<br>Problem solving method |
| **Teaching Forms** | Frontal teaching<br>Individual work<br>Pair work<br>Group work (four students in a group) |
| **Tools** | micro:bit, Scratch, Internet browser, You Tube |

| Resources/materials for the Teacher | Scratch, Internet browser, game examples in Scratch, You Tube | |
|---|---|---|
| Resources/materials for the Students | micro bit game, Scratch | |
| Teaching summary | *Motivation-Introduction*<br>In the motivation part, students work in pairs to play a game of computing with the micro: bit<br><br>Each member of the pair plays with a programmed micro: bit to display numbers from 1 to 10.<br><br>By shaking the micro bit, the first member of the pair gets a certain number. Another member of the pair is given another number by the same procedure. The values obtained should be shown as a calculation action and their total value should be calculated. After calculating their common value, students should also apply the commutative property of the sum.<br><br>The guided conversation follows: How did you feel while you were using micro:bit? What did the micro:bit remind you of? In which social game could it be applied? How often do you play games? What are your favorite games? Who makes the games?<br><br>The introduction of the activity based on a fairy tale. Listening to the audio fairy tale "Sleeping Beauty" https://www.youtube.com/watch?v=9MIsZBhsQtA<br><br>OBJECTIVE ANNOUNCEMENT: Today you will be the creators of a computer game. | Duration<br><br><br><br><br>30 min |
| | *Implementation*<br>Research Question: How could we add a little math to a fairy tale? What would the main character do, how would he/she get to Sleeping Beauty? Which way would he/she go? What would he/she do on his/her way?<br><br>(Students cite examples)<br><br>Now let's look at one example of a game in Scratch:<br><br>https://scratch.mit.edu/projects/270953940/<br><br>The subsequent part is group work with a goal to design computational tasks in a set of numbers up to 20.<br><br>The students are divided into four groups of four students each.<br><br>Group 1 has a task to design 5 numerical expressions with addition and subtraction up to 10.<br><br>Group 2 has a task to design 5 numerical expressions with addition and subtraction up to 20.<br><br>Group 3 has a task to design 5 word-given tasks in a set of numbers up to 20 with addition. | 30 min |

| | | |
|---|---|---|
| | Group 4 has a task to design 5 word-given tasks in a set of numbers up to 20 with subtraction. | |
| | *Reflection and evaluation*<br>- playing the designed game<br>- satisfaction questionnaire for the conducted activity | 30 min |
| **Annexes** | Learning scenario in LePlanner:<br>https://beta.leplanner.net/#/scenario/5d727c6b80a288cd3abb871e<br><br>Satisfaction questionnaire<br><br>Story/game scenario "Computational Castle" | |
| **Examples and game references** | Developed Scratch game – Computational Castle<br>https://scratch.mit.edu/projects/326503995/ (30.7.2019.)<br><br>Sleeping Beauty - Audio Tale (in Croatian):<br>https://www.youtube.com/watch?v=9MIsZBhsQtA (30.8.2019.)<br><br>Scratch – Story/game Snow White:<br>https://scratch.mit.edu/projects/270953940/ (30.7.2019.) | |

# Annex: Satisfaction questionnaire

1.  HOW DID I FEEL IN TODAY'S MATHEMATICS?

POOR                    GOOD                    EXCELLENT

2. HOW DID YOU LIKE WORKING IN THE GROUP?

POOR                    GOOD                    EXCELLENT

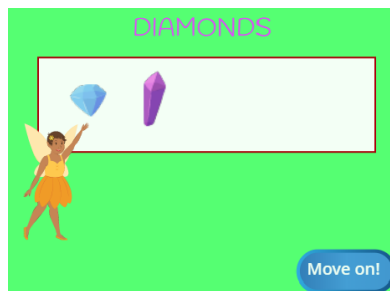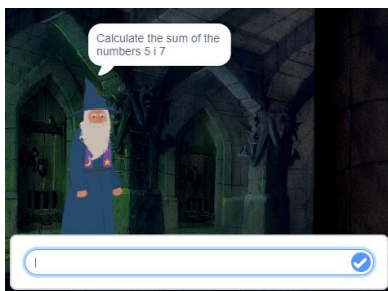3. HOW DO YOU LIKE WORKING WITH COMPUTERS?

DON'T LIKE              LIKE IT                 GREAT

## Annex: Game/story scenario

| Title of the game | Computational Castle |
|---|---|
| Type | Scratch story with game elements |
| Course/ Grade | Mathematics - Adding and subtracting numbers up to 20<br><br>1st grade of primary school |
| Learning outcomes | • Independently sum and subtract numbers from 1 to 10 (1st level)<br>• Independently sum and subtract numbers up to 20 (2nd level)<br>• Independently solve simple word problems (3rd level) |
| Goal of the game | Solve tasks of addition and subtraction of numbers up to 20. |
| Characters and their roles | The king's vassal, the supporting character: the proclaimer<br><br>Young Prince, the main character: solves the tasks<br><br>King, the supporting character: golden key bearer<br><br>Fairy, the supporting character: gives the instructions<br><br>Princess, the supporting character: happily get out of the castle. |
| Description of the game flow | The king's vassal makes a proclamation promising to give the princess to the one who comes to the golden key. If the young Prince correctly solves the tasks, he will get a golden key that unlocks the castle door and meet the princess, otherwise he becomes a dog and returns to the beginning of the game. |
| List of scenes / backgrounds | 1. The king's vassal make a proclamation - a settlement with a square<br>2. Road to the castle with hidden tasks<br>3. Castle on the hill<br>4. The interior of the castle<br>Note: Scene for inaccurate solutions - turning Prince into a dog |
| Logical mini-games within the story | **1. task:** Prince has to collect a certain number of apples or watermelons. Number is set with numerical expressions of addition or subtraction. Each correct answer is one point. To pass the level player must collect 10 points.<br><br>**2. task:** The maze - Prince moves around the maze and collects 5 diamonds. When Prince reaches the diamond, he must correctly answer the calculus to collect it. Prince exits the maze trough the yellow door which opens only if all diamonds are collected.<br><br>**3. task:** The King asks the final question. If Prince answers correctly, he will get the princess, otherwise the King turns him into a dog and you lose the game. |
| End of the game | The game ends when Prince gets the golden key to unlock the castle and meet the princess. |

# Screenshots from the game

| | |
|---|---|
| **Title of the game** | Hlapić plays with words |
| **Type** | Scratch story with game elements |
| **Course/ Grade** | Croatian language<br>3rd grade of primary school |
| **Learning outcomes** | • recognize different word classes (nouns, verbs, adjectives)<br>• apply the lessons learned in designing and playing the game |
| **Goal of the game** | To find his lost friends Gita and Bundaš in a castle, a boy named Hlapić needs to recognize different word classes (nouns, verbs, adjectives). |
| **Characters and their roles** | Hlapić – the main character, in search of Gita and Bundaš<br>Bundaš – supporting character<br>Gita – supporting character<br>Black Man – a negative character in the story, returns the game to the beginning if the player answers the questions incorrectly |
| **Description of the game flow** | Pressing the green flag starts the game. The main character Hlapić appears and explains his problem: Black Man imprisoned his friends Gita and Bundaš in a castle. In order to free them, the player should help Hlapić to solve three tasks.<br><br>To get the key to the castle, Hlapić must solve the first task - recognize word classes (nouns, verbs, adjectives) and sort the word on a board. After completing the task successfully, Hlapić enters to the castle and talks to the Black Man about Gita and the Bundaš. The Black Man has another task for Hlapić because he does not want to release his friends easily.<br><br>In the second task, the player must find the verb in a given sentence and type it in a specific field. After the correct answer, the Black Man releases Gita and she and Hlapić continue their search for Bundaš. But again, they come across the Black Man who sets a new task for them.<br><br>In the third task, the player must collect a certain number of nouns to release Bundaš. If the player collects certain number of points throughout the game, Black man releases Bundaš and then Hlapić, Gita and Bundaš leave the castle. |
| **List of scenes / backgrounds** | 1st scene : meadow - Hlapić introduces the player to the story<br><br>2nd scene: Hlapić heads to the castle<br><br>3rd scene: board - Task 1: Sort word types<br><br>4th scene: Hlapić gets the key so he unlocks the door of the castle and enters<br><br>5th and 6th scene: In the castle Hlapić meets Black Man who gives him a task – Task 2: find and type the verb in the specified field<br><br>7th, 8th, and 9th scene: wall – Task 3: Collect nouns<br><br>10th scene: All the characters meet outside the castle and leave |
| **Logical mini-games within the story** | Task 1: The player must sort the words according to classes they belong. Player scores 2 points for each correct answer. The maximum number of points is 18. In |

| | case of a mistake, the player does not lose points but he/she cannot continue with the game until all the word are sorted correctly. |
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| | Task 2: The player must find the verb in a given sentence and type it in a specific field. If the player types the verb correctly, the game goes on and two points are scored, but if the player types the wrong verb, he/she can try again. |
| | Task 3: The player must collect a certain number of nouns to the basket to release Bundaš. For each noun, the player wins 2 points. If the player accidentally picks up the verb, there are no negative points. |
| **End of the game** | If the player successfully completes three tasks, the Black Man releases Gita and Bundaš and they leave the castle with Hlapić. |