Games for Learning Algorithmic Thinking

Workshop 2: PBL, online quizzes and logical tasks

Session 4: Digital tools within the process of problem solving

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The main goals of GLAT project

- Algorithmic thinking is developed by using skills for **solving various problems that reflect real issues**
  - Related to **problem-solving skills, logic and creativity**

HENCE ... **Problem solving**

KEEP CALM AND PROBLEM SOLVE

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Outline

1) Introduction
   - What is problem solving?
   - Why is it important?
   - What does it take to be able to solve a problem?
2) The problem solving skills
   I. Analytical thinking
   II. Creative thinking
   III. Team work
3) Developing the problem-solving skills
4) Digital tools for enhancing problem solving skills

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1) Introduction
Why we talk about problem solving?

- **Problem solving skills lead toward developing algorithmic thinking**
- Problem solving is part of everyday life …
  - we continually make and execute algorithms
  - we design series of activities

This world is fully comprehensible **only for those who are familiar with the basics of these activities.**

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The process

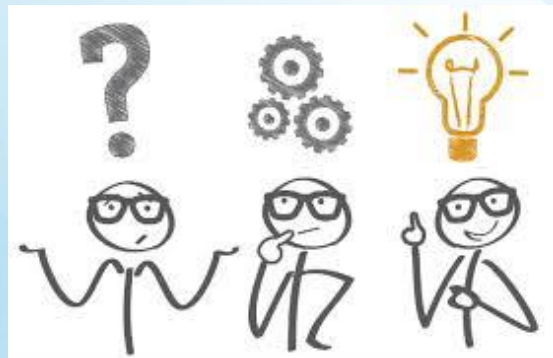---

Let's answer, **what** is problem solving?

- We meet problems in our everyday life

- Some problems that students have (younger and older):

    - How to travel from home to school
    - How much money is needed to buy bred and something sweet ☺
    - Planning the allowance to last till the end of a week
    - Developing a strategy to reach the next level of a computer game
    - Debugging a computer program
    - …

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The most important skill

- Problem-solving is the ability to deal with problems

  - To identify
  - To solve
- Do it systematically !!!

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Advantages of learning problem solving

- Employing science processes – STEM education
- Employing science processes in non-science subjects, daily life
- Problem solving develops HIGHER thinking skills
- Develops responsibility, creativity, resourcefulness, critical thinking
- The students learn to accept opinions and evidence shared by others – TEAM work

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Problem solving is a process…

- **Problem-solving** is a process—an ongoing activity in which we take what we know to discover what we don't know.

- Problem-solving involves three basic functions:
  - Seeking information
  - Generating new knowledge
  - Making decisions

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2) What does it take to be able to solve a problem?

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

  - Analytical Ability
  - Creative Thinking

    - Initiative
    - Persistence

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I. Analytical and critical thinking skills

- **Analytical and critical thinking skills** helps to evaluate the problem and to make decisions.

Analytical Thinking

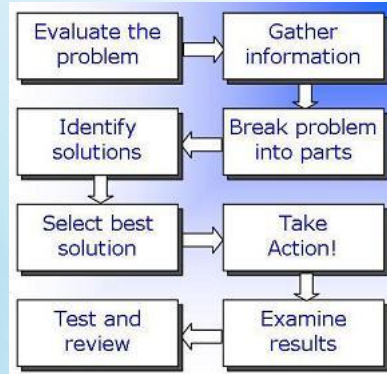| Logical	Objective	Sequential
Rational	Focused	Deductive
Linear	Convergent	Systematic

THE five steps model

A **logical and methodical approach** in finding solution using **5 five-steps model**

- has direct applications to many areas of the curriculum and everyday life:

1. Understand the problem
2. Analyze the problem
3. Identify various solutions
4. Try out a solution
5. Evaluate the results
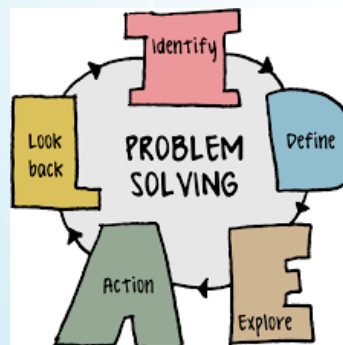
In other words.. stages to solving a problem
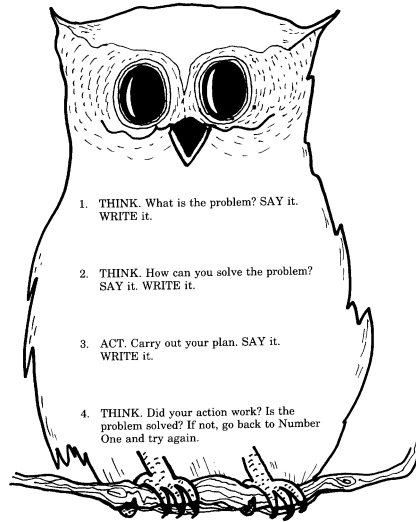
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The five steps model

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This can help…

- Source: https://www.teachervision.com/search?teachingstrategies=Problem%20Solving

The Wise Old Owl

1. THINK. What is the problem? SAY it. WRITE it.

2. THINK. How can you solve the problem? SAY it. WRITE it.

3. ACT. Carry out your plan. SAY it. WRITE it.

4. THINK. Did your action work? Is the problem solved? If not, go back to Number One and try again.

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Let's learn through example

- The 5 steps through an example
- Dabar, Croatia
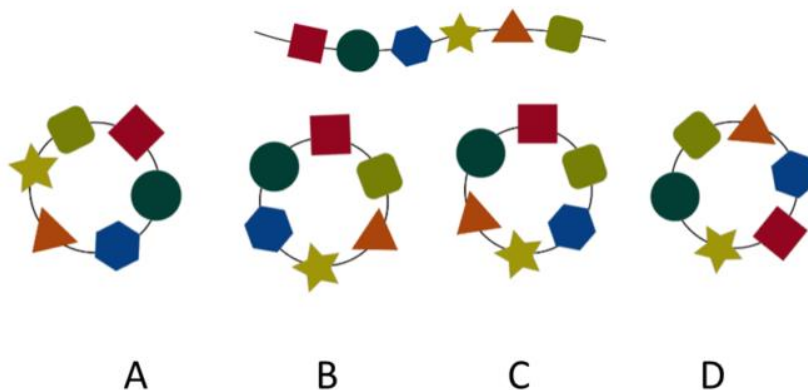
http://ucitelji.hr/vjezbaliste/

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Primjer 1. Koja narukvica odgovara?

A   B   C   D

1. Understand the problem

- It's important that students understand the nature of a problem and its related goals.
- Encourage students to frame a problem in their own words.
- Spread-sheets helps

- *What do you know*
- *What do you need to find*

1. Understand the problem - Example

Let's do it!

- How would you describe the problem?

…

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

Where to now? ☺

2. Analyzing the problem

- **Describe any barriers (obstacles)**
- In short, what is creating the problem?
  - Encourage students to verbalize these obstacles is always an important step.

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2. Analyzing the problem

Techniques to understand the nature of a problem and its conditions

- *List all related relevant facts.*
- *Make a list of all the given information.*
- *Restate the problem in your own words.*
- *List the conditions that surround a problem.*
- *Describe related known problems.*

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2. Analyze the problem – the Example

- 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 needs to be in the same order in the bracelet
- Obstacles:
  - The order is not symmetrical

3. Identify various solutions

- There are MANY strategies and no single strategy will work for all problems.
- Some problem-solving possibilities:
  - *Create visual images*
  - *Create a table*
  - *Use physical objects*
    - By moving objects around on a table or desk, students can develop patterns and organize elements
  - *Work backward*
  - *Look for a pattern*
  - *Create a systematic list (table)*

3. Identify various solutions – the Example

- The possible solutions are offered
  - See if the solution is meeting the conditions and avoids the obstacles
- The student can draw their idea of a solution and then compare to the offered ones
- The student can move the objects to organize elements

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4. Try out a solution

- important clues
  - Keep accurate and up-to-date records of student thoughts, proceedings, and procedures.
  - Try to work through a selected strategy or combination of strategies until it becomes evident that it's not working
    - it needs to be modified
    - it is yielding inappropriate data
  - Monitor with great care the steps undertaken as part of a solution

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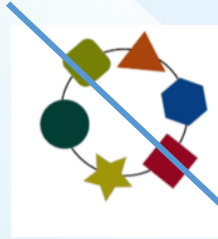Erasmus+ Programme
of the European Union
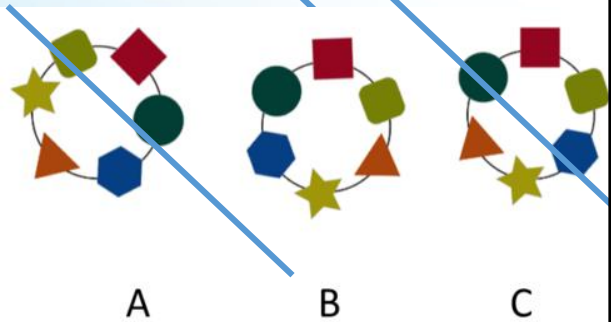
4. Try out a solution – the Example

- Eliminate the ones that don't meet the first condition:

the ends of the string must be next to each other: **D**

- Eliminate the ones (A, B, C) that don't meet the second condition:

The shapes needs to be in the same order in the bracelet as in the string

A   B   C

5. Evaluate

- Students should SELF - measure their problem solving skills
- Independence!
- Maybe ask the 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?"***

5. Evaluate – the Example

- The solution is B

- More examples, after the lecture ☺

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II. Creative thinking

- Sometimes, **creative thinking** will be necessary
  - ideas for resolving the problem and find fresh approaches

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Examples of creative solutions ☺

III. Don't forget… TEAM work

- **Team working is often a key component in problem-solving**
  - Not everyone has analytical and critical thinking potential
- The students learn to accept opinions and evidence shared by others
  - **Latter about Role playing in team working**

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Why Groups are
More Effective Decision Makers

- Only one might not have all the knowledge or resources to find the solution
- Groups "see" from different angles
- Group easier test different ideas before one is selected and implemented

3) 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;

4) Enhancing Problem solving skills with games

- Utilizing digital tools
- We need digital competence (latter…) to choose the right games – edu-websites
- https://www.funbrain.com
  - an award-winning interactive learning and "edutainment Web site" links K-8 children, parents, and teachers. It gives a choice of math problems and the level you want to practice.
- **Iknowthat.com**
  - High energy, engaging games in math, Language Arts, Science, Social Studies, The Arts, and thinking games all to be found here either by subject or grade level.

Some games for elementary school

- https://www.funbrain.com/pre-k-and-k-playground
  - Fun games for warming up
- https://www.funbrain.com/games/pig-pile
  - Fun game for logical que of steps
- https://www.funbrain.com/games/word-derby
  - English language
- https://www.funbrain.com/games/inkster
  - Math (grade 3-4)

Utilizing technologies

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

  BUT also
  - people who provide information, feedback and inspiration.

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Conclusion

- Problem solving skills lead toward developing algorithmic thinking
- Problem solving is part of everyday life …
- The key problem-solving skills:
  - Analytical thinking
    - logical and methodical approach
    - The 5 steps
  - creative thinking
- Digitalization helps developing the problem solving skills even in students of elementary school
  - Fun educational games in the classroom
  - Developing algorithmic thinking!

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More references

- TeacherVision
  - https://www.teachervision.com
- Lumosity.com