

Problem solving

INTRODUCTION

Problem-solving has been a major topic in mathematics education since the publication of the seminal booklet “How to solve it” by George Pólya (1945).

He proposed the following steps when solving a [mathematical problem](#):

- First, you have to understand the problem.
- After understanding, make a plan.
- Carry out the plan.
- Look back on your work. How could it be better?

If this technique fails, Pólya advises: “If you cannot solve the proposed problem, try to solve first some related problem. Could you imagine a more accessible related problem?”

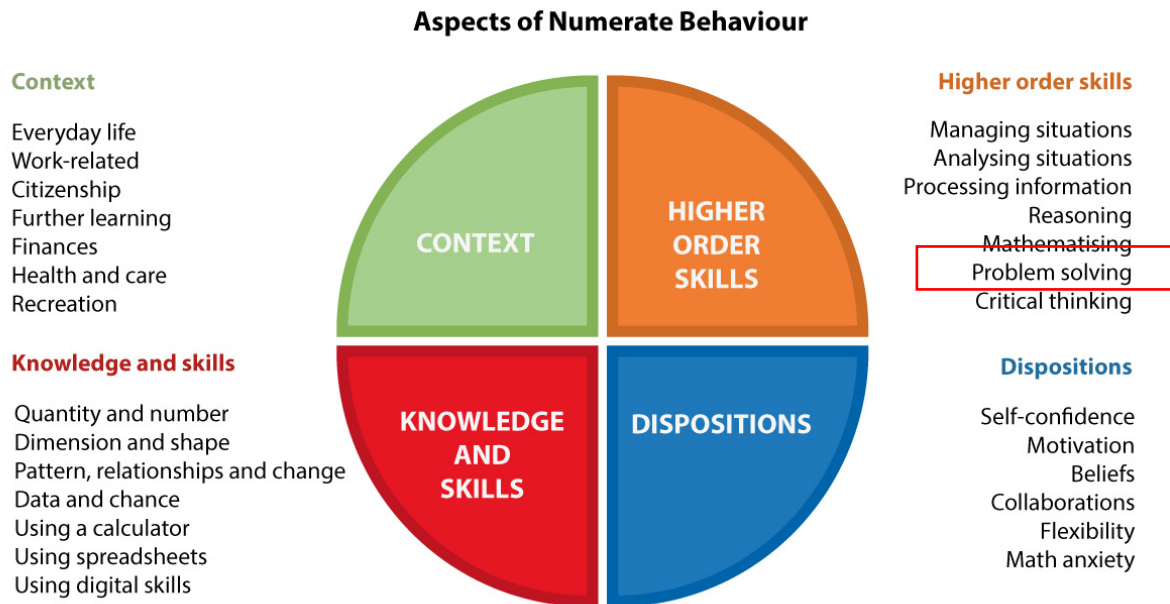
The question now is how applicable this is for a numeracy class in adult education. The problems to solve are not the textbook school mathematics problems, but problems from real life.

KEY ISSUES

- How to use the ideas behind (Polya’s) problem-solving to improve the quality of numerate behaviour of the learners?
- Problem-solving requires a disposition of resilience. Learners have got the idea for earlier educational experiences that you have to work towards one answer, which is right or wrong. And that there is one way to reach such an answer. However, nor in mathematical problem solving, nor in daily problem solving this is true. In most cases you have to try different approaches, reflect on the process and change your approach when necessary.
- Problems brought into the lesson by learners are more effective than problems from a textbook constructed by educational authors. It helps when learners can relate to the problem.



RELATION TO CENF



SUGGESTIONS FOR PD MEETINGS

1. *Discussing personal experiences*

Collect from the participants examples from their own life in which they use numeracy to solve a problem. Describe the situation and the (numerate) action taken. Try to extract which specific skills are being used in these situations. Refer this to the CENF and see if you can find match the skills to those mentioned in the CENF.

2. *PIAAC*

Find the pieces in the Assessment Frameworks for Cycle 2 of the Programme for the International Assessment of Adult Competencies, that refers to problem-solving. Try to illustrate those pieces with everyday situations.

Source: OECD. (2021). The Assessment Frameworks for Cycle 2 of the Programme for the International Assessment of Adult Competencies. OECD. <https://doi.org/10.1787/4bc2342d-en>



BACKGROUND INFORMATION

1. Principles of Polya's approach

We elaborate a bit on the first two principles of Polya's approach

First principle: Understand the problem

Pólya taught teachers how to prompt each student with appropriate questions, depending on the situation, such as:

- What are you asked to find or show?
- Can you restate the problem in your own words?
- Can you think of a picture or a diagram that might help you understand the problem?
- Is there enough information to enable you to find a solution?
- Do you understand all the words used in stating the problem?
- Do you need to ask a question to get the answer?

Second principle: Devise a plan

Pólya mentions that there are many reasonable ways to solve problems. The skill at choosing an appropriate strategy is best learned by solving many problems. You will find choosing a strategy increasingly easy. A partial list of strategies is:

- Guess and check
- Make an orderly list
- Eliminate possibilities
- Use symmetry
- Consider special cases
- Use direct reasoning
- Solve an equation
- Look for a pattern
- Draw a picture
- Solve a simpler problem
- Use a model
- Work backward
- Use a formula
- Be creative
- Applying these rules to devise a plan takes your own skill and judgement.

Pólya lays a big emphasis on the teachers' behaviour. A teacher should support students with devising their own plan with a question method that goes from the most general questions to more particular questions, with the goal that the last step to having a plan is made by the student. He maintains that just showing students a plan, no matter how good it is, does not help them.



2. PIAAC

The problem-solving in real-life situations has been mentioned explicitly in the frameworks used for the large scale assessments on literacy and numeracy, like IALS, ALL, and PIAAC. The following definition of numerate behaviour, was adopted for PIAAC Cycle 1:

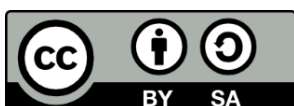
“Numerate behaviour involves managing a situation or solving a problem in a real context, by responding to mathematical content/information/ideas represented in multiple ways.”

The scheme below is used to unravel the aspects of numerate behaviour. In this definition the concept of managing a situation or solving a problem is broken down in meaningful and concrete details.



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