

## Teaching Problem-Solving Skills from Metacognitive Perspective

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**Abstract:** The topic emphasized here advances the idea of education for sustainable development that empowers learners to be globally competent and competitive professionals. The author concentrates attention on the thinking skills we would like our students to exhibit when addressing unstructured problems, emphasizing the issue of metacognitive instruction, which helps to translate general directions of thinking-based approach into applications for the classroom. This will be followed by describing performance pattern. The proposed thinking organizer for problem solving can be consumed as a conscious technique which models the process of inquiry and presents in a structured fashion the search for solutions. The vital aspect is that intellectual excitement of questioning and an explicit emphasis on skilful thinking makes students function in a metacognitive way with learning focused towards higher order thinking.

**Key words:** Education • Thinking skills • Metacognitive instruction • Performance pattern

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### INTRODUCTION

While postmodern social systems are undergoing a rapid transformation, the most important assets of the Knowledge society - good education, creativity and competence - are growing in strength. The ultimate aim of education in the period of numerous technological and informational advances is to enable students to develop a wide variety of high literacy skills that compound global competence; apply and transfer their thinking capabilities to everyday life situations both in the world of work and in society as a whole; enhance and extend their problem-solving (PS) abilities for the future.

Productive thinking is an essential element of making a well educated global citizen in the 21<sup>st</sup> century. The comparative analysis of all-embracing frameworks for cultivating intellectual thinking and global competence (Boix Mansilla, Jackson, Jonassen, Krathwohl, Marzano, Romiszowki, Swartz, Wallace [1-7] detects the classifications of productive thinking which involve the category of problem solving. From there, fostering good thinking for the Global Age can be conceptualized into a format of teaching for cross functional competency of problem-solving. As M.J. Dreher notes "...workplace literacy in the XXI millennium is synonymous with problem-solving" [8]. That is to say, the appropriate kind of education for the new social reality essentially involves teaching the capacity to tackle the problems of local and global significance with the reference to creating

opportunities for effective action. In all conscience it is our job as educators to assist the process for better thinking in the classroom and to equip students with the skills and strategies to think productively.

**Theoretical Background:** The repertoire of good problem solving skills and traits includes: understanding, anticipating, judging, hypothesizing, making priorities, utilizing discernment, presenting logical arguments, generating possible solutions, exploring ideas, analyzing components and relationships, making inferences and interpretations from data, evaluating the relative worth of options. In anticipation that PS is a case of higher order thinking [9] the question is how to best instruct students in this kind of thinking.

In order that PS component be incorporated in the classroom, teachers need something more than simply to be asked to use problem-based activities and students need something more than simply to be asked to do use PS strategies. Implementation of these strategies may appear difficult in educational practice and requires a slight shift in approach to the curriculum. The underlying reason given for this shift in approach is a perception that conventional teaching process lacks the capacity to produce self-regulated learners [10].

A synthesis of studies produces a general framework for teaching thinking across curriculum. This is applicable to problem solving and includes the following key ideas.

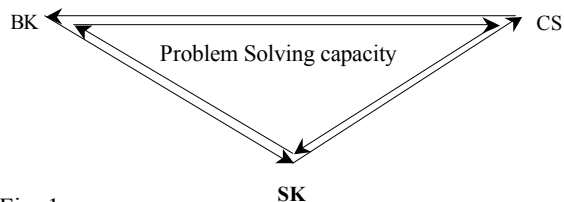


Fig. 1:

- Good thinking is learnable by all students [11, 12, 13].
- People learn most easily when they possess organizing schema to use to interpret and elaborate [14].
- Operating within a metacognitive perspective is essential to cognition and enhances intellectual development [15].
- Since not effective when taught in isolation, skill and content must be taught at the same time [12, 13, 16].

All subjects provide pupils with opportunities to respond to the challenge of perplexing situations. As such, PS instruction must be integrated across key curricular subjects, with the use of opportunities where both the content area and the PS skills can be taught in a complementary manner. In fact, based on the underpinnings of the pre-cited conceptual assumptions, effective problem-solving process depends on the successful interaction among three factors: background knowledge (BK), cognitive skills (CS) and strategic knowledge (SK).

*Background knowledge* represents the blending of content and understanding of how particular topics, problems or issues are organized. It includes information that is essential for effective performance.

The procedure aimed at resolving a difficult situation involves the use of a number of intellectual operations. This variety includes cognitive skills internal to critical and creative types of thinking and the effective management of the cognitive skills by what is called metacognition.

*Cognitive skills* refer to the conceptual abilities of analyzing, synthesizing, evaluating, generating etc [3]. Applying cognitive resources through metacognitive control cultivates good thinking.

*Strategic knowledge* increases understanding of thinking focused towards PS skills.

The literature reports that teaching self-regulation methodology to students can lead to a marked improvement in their achievements [11, 17]. The processes of self-monitoring, evaluating, revising, orchestrating the thinking skills offer the prospect of learners being less impulsive and becoming autonomous and independent in

their learning and students learn successfully how to handle problems if they are aware of their thinking and can control it.

**Pedagogical Implications:** The vital aspect that can engage students in the complex process of higher-order thinking is to place them in important roles as they work with ill-defined real-world problems. But, derived from a synthesis of research, this won't be enough. The intellectual operation of PS requires sustained concentration, not only on the matter in hand, but also on how a task is conceived. In search of constructive ways to help students develop PS skills we take as a drive gear meta-cognitive instruction intended to enhance intellectual thinking among students. If that's the case the focus of instruction would shift on gaining PS ability through the process-oriented learning when "the emphasis is less on the product and more on the wandering path that learners use to get to the product" [17].

To learn how to successfully handle problems students need to be aware of their thinking and manage to control it. Within the framework of working on the problem the significance of metacognition lies in the sense that it represents planning, consequent regulation, self-monitoring and self-assessment [16] and being involved in meta-cognitive thinking students try to choose an effective plan to solve problems, assess their understanding and gain the perspective they need to fine-tune their practices. From this perspective students can all benefit from tools that provide with guidance to becoming aware of PS practices - language and instrumentalities through which learners can identify and manipulate thought processes. In these circumstances strategic and reflective thinking enable learners to approximate the higher levels of thinking.

**The Pattern of PS:** In this article the researcher employed a model outlined by R. Sternberg. At the core of mental self-management are considered to be the seven metacomponents: recognising the existence of a problem, defining the nature of the problem, generating a series of steps needed to solve the problem, combining these steps into a workable strategy for problem solution, deciding how to represent information about the problem, allocating mental and physical resources to solving the problem and monitoring the solution to the problem. These metacomponents have been operationalised to measure metacognitive functioning and used for the enhancement of both academic and real-life problem solving skills.

Table 1: Worksheet #1: Defining the Nature of the Problem

1. Identifying the problem (Clarity of the problem is determined by what precisely one wants and one has)
  - 1.1. Develop an understanding of the problem: divide it into manageable pieces or subproblems if possible.
  - 1.2. Is this the real probability, or merely a symptom of a larger one?
  - 1.3. Define the problem in your own words:

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*The problem is:*

- II. Exploring the Problem (gather information and analyze it to pinpoint the problem area and see a range of reasons)
  - 2.1. Who says that is a problem?
  - 2.2. Who caused or causing the problem?
  - 2.3. Whom does it or will it affect?
  - 2.4. Who has done something about the problem?
  - 2.5. What happened / happening / will happen?
  - 2.6. What are the symptoms?
  - 2.7. What are the consequences for others?
  - 2.8. What circumstances surround the occurrence of the problem?
  - 2.9. What is not functioning as desired?
  - 2.10. When did / is / will it happen / happening?
  - 2.11. Where is the problem occurring?
  - 2.12. Where did it have the impact?
  - 2.13. Did it or will it occur ?
  - 2.14. Why did it occur ?
  - 2.15. Why was nothing done to prevent the problem?
  - 2.16. Why is a response needed now?
  - 2.17. How should the process be working?
  - 2.18. How do you know this is a problem?

From - comparison

- signals
- checklists
- complaints
- brainstorming

Define the root cause

*The root cause is .....*

Table 2: Worksheet #2: Planning a Solution

3.1. Write down a goal statement (what is the successful end of the process?)

3.2. Look at alternatives to create a recommended solution:

Collect as many various alternative solutions as possible through such techniques as

- analysis of past solutions;
- reading;
- researching;
- asking questions;
- discussing;
- brainstorming;
- mind mapping;
- others

Give your explanation about the techniques you used:

IV. Contraction in view of possibilities

Analyze the feasibility of each solution. Think about such factors as costs, time, people, procedures, policies, rules, obstacles, consequences etc. How can they be handled?

	Drawing conclusions in view of possibilities (weigh advantages and disadvantages of each alternative)	
Alternatives and implications	Advantages	Disadvantages
1.		
2.		
3.		

V. Choices

Rate each alternative on the criteria of its possibility and compute the optimal solution  
(prioritize the solutions by their effectiveness)

- 1.
- 2.
- 3.

VI. Create a recommended solution (Pose the best possible solution, which promises optimal outcomes)

Table 3: Worksheet #3: Reflection Stage

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Problem
Solution
1. Which of the approaches did you use when solving the problem?
1.1. Did you adopt "STOP IT" approach?
(seeks to solve the problem so that the problem no longer exist through
-Prevention
-Elimination
-Redirection
1.2. Did you adopt "MOP IT" approach?
(seeks to solve the problem through the strategies as
-Treat it
-Tolerate it
-Redirect it
2. What kind of thinking did you use in addressing the problem:
-rational
-creative
-fantasy
3. Explain the limitations of your proposed solution
4. What feedback have you received from others?
5. What did you learn that will be of use to you for future problems and tasks?
6. What have you learnt while solving this problem?

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High-grade questioning is an effective tool to teach thinking skills. For this reason, taking part in good productive thinking can be modeled in an interlocutory manner. Detailing of a problem solving cycle by means of different types of questions will act as major characteristic of the tool. A distinctive feature of the suggested tool for enhancing PS skills is the maintenance of the area of thinking organized as structured questioning which helps to employ learners's intellectual resource. How this works becomes clearer if we present the layout sheet to assist with a performance task on effective PS.

The cycle first recognizes the existence of a problem, followed by defining the nature of the problem, then allocating resources to problem-solving and representing information about the problem.

Next stage involves formulation of a strategy for problem solution, searching for possible alternate approaches, selecting the most optimal solution.

Finally, students execute self reflection and monitor their achievement. They evaluate their performance in order to understand the process and then sharpen, clarify and refine it.

### CONCLUSION

Good problem solving skills seldom come naturally; they are consciously learnt and nurtured. Throughout proposed self-teaching instrument students can *learn by doing*. They internalize the problem-solving methodology as a result of the process of working on the problem, accompanied by active monitoring and consequent regulation.

The value of this work is in terms of the approach that can be used for all learners and a variety of subject fields; its detailing of a problem solving cycle which can be used widely for the enhancement of both academic problems and real-life problems; the effect of organized thought which results to organized actions.

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