Problem Solving

by

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Abstracts

Behaviorist psychologists thought problems ere solved by trail and error and reproducing past responses. Cognitive psychologists were convinced problem-solving wasn't random but that there was a series of mental processes involved. Problem solving involves mentally working to overcome obstacle that stand in the way of reaching a goal. There are many different ways to represent a problem. A problem can be represented mentally (in your own mind), orally , in writing, on a computer, and so on. Each type of representation has certain advantages and disadvantages. There key steps of problem solving are problem identification, problem definition and representation, strategy construction, organization of information, allocation of resources, monitoring, and evaluation. In everyday experiences, these steps may be implemented very flexibly, such that various steps may be repeated, may occur out of sequence, or may be implemented interactively. Although well-structured problems may have a clear path to solution, the route to solution may still be difficult to follow. When solving ill-structured problems, the choice of an appropriate problem representation powerfully influences the ease of reaching an accurate solution. Additionally in solving ill-structured problems, people may need to use more than a heuristic or an algorithmic strategy; insight may be required. The problems to be solve ant the tasks to be accomplished are challenging. There is explicit instruction on key ideas such as problem posing, working to achieve a clearly defined problem. Building on the previous work of yourself and others. Transfer of learning and

viewing each problem as a learning opportunity. Work to learn thins that will help you in the future. Do metacogintion, do a conscious, considered analysis of the components and the overall process in each challenging problem that you address. All this will help us to get better solving problems.

1.0 Introduction

Problem solving permeates every corner of human activity and is a common denominator of widely disparate fields such as the sciences; law ; education; business; sports; medicine, industry; literature ; and as if there weren't enough problem solving activity in our professional and vocational lives, many form of recreation. Human, apes, and many other mammals are curious types who, for reason seemingly related to survive, seek stimulation and resolve conflict through a lifetime of creative, intelligent problem solving.

A problem is a situation which is experienced by an agent as different from the situation which the agent ideally would like to be in. A problem is solved by a sequence of actions that reduce the different between the initial situation and the goal (F.Heylighen, 1998).

Problem solving is "thinking that is directed toward the solving of a specific problem that involves both the formation of responses and the selection among possible responses." We encounter an untold number of problems in our daily lives that cause us to form response strategies, to select potential responses, and to test responses in solving a problem.

2.0 Representation of the Problem.

There are many different ways to represent a problem. A problem can be represented mentally (in your own mind), orally , in writing, on a computer, and so on. Each type of representation has certain advantages and disadvantages.

From a personal or ownership point of view, you first become aware of a problem situation in your mind and body. You sense or feel that something is not the way you want it to be. You form a mental representation, a mental model, of the problem. This

mental model may include images, sounds or feelings. You can carry on a conversation with yourself- inside your head – about the problem.

Mental representation of problems are essential. You create and use them whenever you work on a problem. But, problems can be represented in other ways; for example, you might represent a problem with spoken words and gestures. This could be useful if you are seeking the help of another person in dealing with problem. The spoken words and gestures are an oral and body language model of the problem.

You might represent a problem using pencil and paper. You could do this to communicate with another person or with yourself. Writing and drawing are powerful aids to memory. You probably keep an address book or address list o the names, addresses, and the phone numbers of your friends. Perhaps it contain additional information such as email addresses, birthday, names of your friends' children and so on. You have learned that an address book is more reliable than your memory. As a conclusion there are still other ways and many ways to represent problems.

The work of the Gestalt psychologists focused on the nature of a task and its influence on a person's ability to solve it. Recent scholars have attacked the question of problem solving from several different perspectives, including what modern cognitive psychologists call the process of representation, or how a problem is depicted in the mind. The way information is represented in solving a problem seems to follow a well-ordered pattern. The stereotypical sequence of problem solving, as suggested by Hayes (1998) are involved cognitive action like Identifying the problem, representation of the problem, planning the solution, execute the plan, evaluate the plan and evaluate the solution.

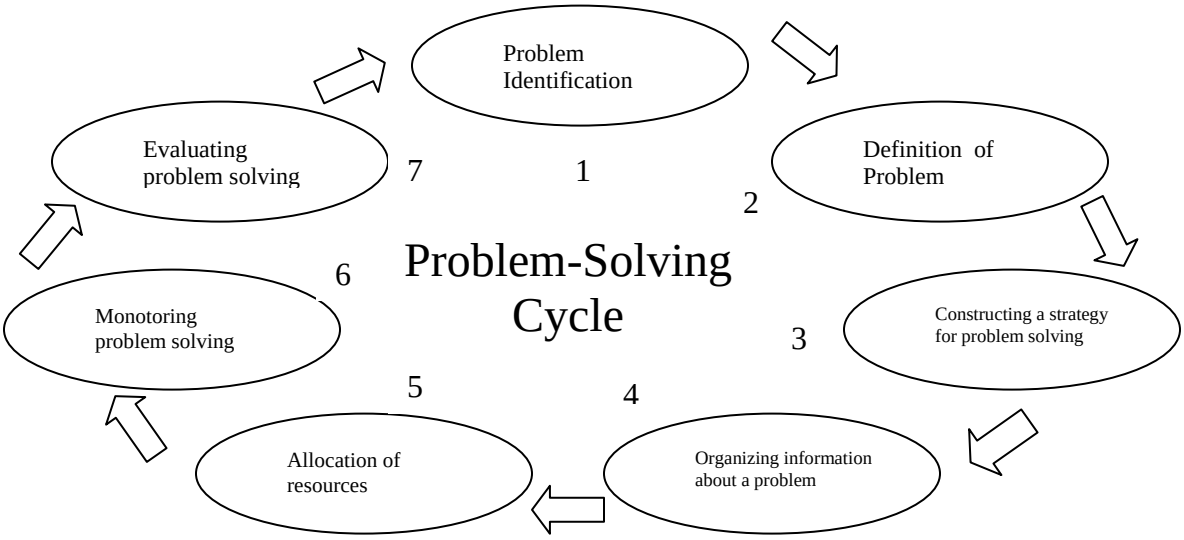
Other representations, such as through writing and mathematics, are useful because they are a supplement to your brain. Written representation of problems facilitate sharing with yourself and others over time and distance. However, a written model is not as easily changed as a mental model. You written word has a permanency that is desirable in some situations, but is a difficulty in others. You cannot merely "think" a change Erasing is messy. And, if you happen to be writing with a ball-point pen, erasing is nearly impossible.

When a problem is represented with a computer, we call this a computer model or a computer representation of the problem. For some problems, a computer model has some of the same characteristics as mental model. Some computer are easy to change and allow easy exploration of alternatives. For example, consider a document that is represented as a word processor file. It may be easier to revise this document than appear and pencils version of the document. A computer can assist in spell checking and can be used to produce a nicely formatted final product.

In the representation of problems, computers are useful in some cases and not at all useful in others. For example, a computer can easily present data in a variety og graphical formats, such as line graph, bar graph, or in the form of graphs of two and three dimensional mathematical functions. But a computer may not be a good substitute for the doodling and similar types of graphical memory-mapping activities that many people use when attacking problems. Suppose that one's mental representation of a problem is in terms of analogy and metaphor. Research that delved into the inner workings of the minds of successful researchers and inventors suggests this is common and perhaps necessary. A computer may be of little use in manipulating such a mental representation.

3.0 Problem Solving Cycle

We engage in problem solving when we need to overcome obstacle in order to answer a question or to achieve a goal. If we can quickly retrieve an answer from memory, we don not have a problem. If we cannot retrieve an immediate answer, then we have a problem to be solved. The steps of the problem solving cycle which are include problem identification, problem definition, strategy formulation, organization of information. Allocation of resources, monitoring and evaluation. In considering the steps remember also the importance of flexibility in following the various steps of the cycle. Successful problem solving may involve occasionally tolerating some ambiguity regarding how best to proceed. Rarely can we solve problems by following any one optimal sequence of problem solving steps. Moreover, we may go back and forth through the steps, change their order as need be, or even skip or add steps when it seems appropriate.



i. Problem identification.

As odd as it sounds, identifying a situation as problematic is sometimes a difficult step. We may fail to recognize that we have a goal, that our path to a goal is obstructed, or that the solution we had in our mind does not work. If your problem is the need to write a term paper, you must first identify a question that your paper will address.

ii. Problem definition and representation

Once we identify the existence of a problem, we still have to define and represent the problem well enough to understand how to solve it. For example, in preparing to write your term paper, you must define your topic well enough to determine the research you will gather and your overall strategy for writing your paper. The problem definition step is crucial because if you inaccurately define and represent the problem, you are much less able to solve it. (Finke, 1991; Hegarty, 1991).

iii. Strategy formulation

Once the problem has been defined effectively, the next step is to plan a strategy for solving it. The strategy may involve analysis – breaking down the whole of a complex problem into manageable elements. Instead, or perhaps in addition, it may involve the complementary process of synthesis – putting together various elements to arrange them

into something useful. In writing your term paper, you must analyze the components of your topics, research the various components, and then synthesize the topics into a rough draft of your paper.

Another pair of complementary strategies involves divergent and convergent thinking. In divergent thinking , you try to generate a diverse assortment of possible alternative solutions to a problem. Once you have considered a variety of possibilities, however, you must engage in convergent thinking, to narrow down the multiple possibilities to converge on a single, best answer or at least what you believe to be the most like solution, which you will try first. There is no single ideal strategy for addressing every problem. Instead, the optimal strategy depends on both the problem and the problem-solvers personal preferences in problem-solving methods.

iv. Organization of information.

Once a strategy has been formulated, you are ready to organize the available information in a way that enables you to implement the strategy. Of course, throughout the problem-solving cycle, you are constantly organizing and reorganizing the available information. At this step, however, you organize the information strategically, finding a representation that best enables you to implement your strategy.

v. Resource allocation

In addition to our other problems, most of us face the problem of having limited resources, including time, money, equipment, space. And so on. Some problems are worth a lot of time and other resource, whereas other problems are worth very few resources. Moreover, we need to know when to allocate which resources. Studies show that expert problem solvers tend to devote more of their mental resource to global planning than do novice problem solvers. Novices tend to allocate more time to local planning than do experts. (e.g., Larkin, McDermott, Simon & Simon 1980; R.J.Sternberg, 1981). For example, better students are more likely to spend more time in the initial phase, deciding how to solve a problem, and then less time actually solving it, than a poorer students (Bloom & Broder, 1950).

vi. Monitoring

A prudent expenditure of time includes monitoring the process of solving. Effective problem solvers do not set out on a path to a solution and then wait until they have reached the end of the path to check where they are (Schoenfeld, 1981). Rather, they check up on themselves all along the way, to make sure that they are getting closer to their goal. If the are not, they reassess what they are doing, perhaps concluding that they made a false start, that they got off track somewhere along the way, or even that they see a more promising path if they take a new direction.

vii. Evaluation

Just as you need to monitor a problem while you are in the process of solving it, you need to evaluate your solution after you have finished. Some of the evaluation may occur right away, the rest may occur a bit later, or even much later. For example , after drafting your term paper you will probably evaluate the draft, revising and editing it quite a few times before turning in your paper. Often, key advances occur through the evaluation process. Through evaluation, new problems may come to light, and new resources may become available or existing ones may be used more efficiently. Hence, the cycle is completed when it leads to new insights and begin anew.

4.0 Types of Problem

Anderson (1988) suggested that there a two different types of problem-solving procedures used. These differentiate between novices and experts.

i. Novices use weak-method procedures

These procedures are domain – independent. It can be applied to any domain. These require substantial mental effort to perform. These are also virtually identical to Newell & Simon's model.

ii Experts use domain-specific procedures

These are combinations of specific problem-solving situations and a series of compiled actions leading to solutions. These solutions are relatively automatically

triggered. These procedures are created by successful repetitions. Examples driving home, flying a plane and playing video games.

5.0 Some Problem-Solving Strategies

A strategy can be thought of as a plan, a heuristic, a rule of thumb, a possible way to approach the solving of some type of problem. For example, perhaps one of the problems that you have to deal with is finding a parking place at work or at school. If so, probably you have developed a strategy for example, a particular time of day when you look for a parking place or a particular search pattern. Your strategy may not always be successful, but you find is useful.

Every problem-solving domain has its own strategies. Research suggests:

1. They are relatively few strategies that are powerful and applicable across all domains. (Breaking a big problem into smaller problems is one of these general-purpose strategies. Doing library research is another general purpose strategy) Each subject matter(each domain) has its own set of problem solving strategies. One needs to know a great deal about a particular domain to be good at solving within that domain.

2. The typical person has few explicit strategies in any particular domain. This suggest that if we help a person gain a few more domain-specific strategies, it might make a significant difference in overall problem solving performance in that domain. It also suggest the value of helping students to learn strategies that cut across many different domains.

The idea of breaking big problem into smaller problems is called the top-down strategy. The idea is that it may be far easier to deal with a number of small problems than it is to deal with one large problem. The use of ineffective strategies is common. For example, how do memorize a set of materials? Do you just read the materials over and over again? This is not a very effective strategy . There are many memorization strategies

that are better. For example, a simple strategy is pausing to review. Other strategies include finding familiar chunks, identifying patterns and building associations between what you are memorizing and things that are familiar to you.

Some learners are good at inventing strategies that are effective for themselves. Most learners can benefit greatly from some help identifying and learning appropriate strategies. In general, a person who is a good teacher in a particular domain is good at helping student recognize, learn, and fully internalize effective strategies in that domain. Often requires that a student unlearn previously acquired strategies or habits.

6. A General Strategy for Problem Solving.

Here is a general six-step strategy that you can follow in attempting to solve almost any problem. This six-step strategy is a modification of ideas discussed in Polya (1957). Note that there is no guarantee of success. However, this six-step might get you started on a pathway to success.

1. Understand the problem. Among other things, this includes working toward having a clearly defined problem. You need an initial understanding of the Givens, Resources, and the Goal. This requires knowledge of the domain of the problem.
2. Determine a plan of action. This is a thinking activity. What strategies will you apply? What resources will you use, how will you use them, in what order will you use them. Are the resources adequate to the task?
3. Think carefully about possible consequences of carrying out your plan of action. Place major emphasis on trying to anticipate undesirable outcomes. What new problems will be created? You may decide to stop working on the problem or return to step 1 as a consequence of this thinking.

4. Carry out your plan of action. Do so in a thoughtful manner. This thinking may lead you to the conclusion that you need to return to one of the earlier steps. It is this reflective thinking that leads to increased expertise.
5. Check to see if the desired goal has been achieved by carrying out your plan of action. Then do one of the following:

- If the problem has been solved go to step 6
- If the problem has not been solved and you wiling to devote more time and energy to it, make use of the knowledge and experience you have gained as you return to step 1 or step 2
- Make a decision to stop working on the problem. This might be a temporary or a permanent decision. Keep in mind that the problem you are working on may not be solvable, or it may be beyond your current capabilities and resources.

6. Do a careful analysis of the steps you have carried out and the result you have achieved to see if you have created new, additional problems that need to be addressed. Reflect on what you have learned by solving the problem. Think about how your increased knowledge and skills can be used in other problem solving situations. (Work to increase your reflective intelligence!)

This six-step strategy for problem solving is worth memorizing. One of goals in teaching problem solving is to have all students memorize this strategy and practice it so that it become second nature. This will help to increase your student' expertise in solving problems. Many of the steps in this strategy require careful thinking. However, there are steadily growing number of situations in which step 5 can be carried out by a computer. The person who is skilled at using a computer for this purpose may gain a significant advantage in problem solving, as compared to a person who lacks computer knowledge and skill.

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