

PROBLEM SOLVING

Authored by
mohammad looti

October 16, 2025

RECOMMENDED CITATION

mohammad looti (2025). *PROBLEM SOLVING*. PSYCHOLOGICAL SCALES. Retrieved from <https://scales.arabpsychology.com/?p=47374>

PROBLEM SOLVING

Primary Disciplinary Field(s): Cognitive Psychology, Education, Artificial Intelligence, Ethology

1. Core Definition

Problem solving is fundamentally defined as a directed, goal-oriented cognitive process undertaken by an individual or a system to overcome a specific obstacle or gap between a current state and a desired end state. The process begins at a clearly identifiable **starting point** and continues through a sequence of operations until a successful **conclusion is reached**. This journey necessitates the application of both existing knowledge and novel strategies to navigate barriers that prevent immediate achievement of the goal. In cognitive psychology, this process is understood not merely as the execution of known algorithms, but as the deployment of **higher mental functions** and creative thinking capacities, particularly when the solution path is not immediately obvious or requires restructuring of the perceived problem space.

The complexity of problem solving varies significantly depending on the nature of the task. Well-defined problems, such as mathematical equations or puzzles, have clear goals, specified constraints, and obvious operators. Conversely, ill-defined problems, common in real-world scenarios (e.g., planning a career, resolving conflict), lack clear goals and may require extensive effort simply to structure the problem itself before any solution attempts can commence. Regardless of definition, effective problem solving represents a critical adaptive skill, reflecting an organism's capacity to adjust its behavior and cognition in response to environmental demands and novel challenges.

2. Primary Disciplinary Field(s) and Classification

While rooted primarily in **cognitive psychology**, the study of problem solving is inherently interdisciplinary, drawing heavily from fields such as education, computer science, and ethology. Cognitive psychologists analyze the internal mental operations--such as memory retrieval, attention allocation, and executive function--that facilitate solution generation. Educational researchers focus on pedagogical methods designed to enhance problem-solving skills in academic and professional settings, often classifying problems based on required skill types (e.g., conceptual, strategic, procedural).

In the realm of Artificial Intelligence and computer science, problem solving is formalized through algorithmic approaches, where the objective is to design systems (like the **General Problem Solver**, or GPS) capable of efficiently searching a vast state space to locate the optimal goal state. Furthermore, management science and organizational behavior apply problem-solving frameworks to address complex organizational challenges, developing standardized methodologies like root

cause analysis and Six Sigma processes. This multi-faceted examination underscores the universal relevance of effective problem resolution across biological, mechanical, and social systems.

3. Etymology and Historical Development

The formal study of problem solving gained significant traction in the early 20th century, largely influenced by the German school of **Gestalt psychology**. Gestalt theorists, notably Wolfgang Köhler, challenged the purely behaviorist view that learning was solely a result of trial-and-error, introducing the concept of **insight**--the sudden realization of a solution achieved through restructuring the problem elements. Köhler's famous experiments with chimpanzees demonstrated that solutions could arise from internal mental manipulation rather than blind response reinforcement.

Following World War II, the field shifted dramatically with the advent of the **information-processing paradigm**. Researchers like Herbert Simon and Allen Newell modeled the human mind as a system processing information, leading to the development of early AI programs designed to mimic human problem-solving strategies. This approach provided a crucial framework for understanding how limited cognitive resources (such as working memory) are managed during complex tasks, establishing problem solving as a sequence of identifiable steps, or operators, applied to move from the initial state toward the goal state.

4. Cognitive Processes and Human Models

In humans, successful problem solving relies upon a complex interplay of cognitive faculties, significantly exceeding simple stimulus-response mechanisms. It involves executive functions managed primarily by the prefrontal cortex, including planning, inhibitory control, and cognitive flexibility. The involvement of **creative thinking** is essential when standard solutions fail, requiring the individual to generate novel approaches, often through divergent thinking or analogical reasoning, by drawing comparisons between the current problem and previously solved, superficially unrelated problems.

One widely used descriptive model is the IDEAL framework, which outlines the necessary stages: **I**dentify the problem, **D**efine and represent the problem, **E**xplore possible strategies, **A**ct on the chosen strategy, and **L**ook back and evaluate the effects. This linear model, while often simplified, highlights the cyclical nature of problem solving, where evaluation frequently leads to re-identification or re-definition of the problem, particularly in ill-defined contexts. Furthermore, expertise plays a substantial role; experts typically possess deep domain-specific knowledge organized into schemas that allow for rapid recognition of problem structures and selection of effective solution paths, bypassing the lengthy trial-and-error characteristic of novices.

5. Problem Solving in the Animal Kingdom

The capacity for problem solving is not exclusive to humans but is widely cataloged throughout the **animal kingdom**, particularly in comparative psychology and ethology studies. Research often utilizes controlled environments, such as mazes, puzzle boxes, and conditioning tests, to quantify an animal's ability to use acquired information to obtain hidden rewards or overcome physical barriers. Such studies reveal a wide range of problem-solving strategies, suggesting evolutionary adaptation tailored to specific ecological niches.

For instance, primates demonstrate sophisticated tool use and planning, while corvids (crows and ravens) exhibit complex causal reasoning. A frequently observed behavioral strategy in learning and simple problem-solving scenarios is the **win-stay** strategy, where an animal repeats a behavior that yielded a reward in the past, contrasting with more complex strategies like 'win-stay, lose-shift.' These observations confirm that even basic problem resolution--the capacity to initiate a process at a starting point and persist until a conclusion is reached--is a fundamental biological necessity for survival and adaptation across species.

6. Key Strategies and Heuristics

When attempting to solve a problem, individuals employ either guaranteed methods (algorithms) or flexible rules of thumb (heuristics). Algorithms, if applicable and followed correctly, guarantee a solution but are often too time-consuming or unavailable for complex problems. Heuristics, conversely, offer mental shortcuts that significantly reduce the cognitive load and search space, though they carry the risk of failure or suboptimal solutions.

Key strategies employed include **Means-Ends Analysis**, where the distance between the current state and the goal state is continually minimized by identifying and applying operators that reduce that distance; this strategy requires setting intermediate subgoals. Another critical heuristic is **Working Backward**, starting from the desired goal state and identifying the necessary preceding steps, often utilized in planning or design tasks. The selection of the appropriate strategy is critical and often determines the efficiency and success of the entire problem-solving endeavor.

7. Significance and Applications

The ability to effectively solve problems is recognized as a cornerstone of functional intelligence and a critical determinant of success across virtually all human endeavors. In educational settings, the focus has shifted from rote memorization to fostering critical thinking and problem-solving competencies, preparing students for dynamic, complex professional environments. Curricula emphasizing project-based learning and inquiry-based science are designed specifically to cultivate strategic and creative thinking skills necessary for tackling novel challenges.

Beyond education, problem-solving methodologies are central to engineering, medical diagnosis, and technological innovation. Engineers use systematic decomposition and iterative testing to solve design flaws, while clinicians rely on diagnostic protocols to move from symptoms (the problem state) to an effective treatment (the goal state). The global economy increasingly values individuals and teams who can apply both analytical rigor and creative flexibility to resolve unforeseen difficulties, making sophisticated problem-solving capacity a highly demanded skill in the modern workforce.

8. Debates and Criticisms

A significant ongoing debate within cognitive science concerns the extent to which problem-solving skills are **domain-general** versus **domain-specific**. Domain-general theories suggest that intelligence and strategic thinking can be applied universally, regardless of the problem's content. Conversely, domain-specific arguments posit that expertise in a particular area fundamentally alters the way problems are perceived and solved, making general skills less relevant than deep, structured knowledge. Current consensus often suggests an interaction, where foundational general skills enable learning, but true expertise requires domain-specific knowledge structuring.

Further critique targets the limitations of traditional laboratory models, which often rely on simple, well-defined puzzles that fail to capture the complexity, emotional investment, and inherent ambiguity of real-world problems. Critics argue that focusing too heavily on algorithms and heuristics overlooks the crucial role of motivation, metacognition (thinking about thinking), and environmental context, which often dictate solution success outside controlled experimental settings. The phenomenon of "fixation" or "functional fixedness," where prior knowledge hinders novel solutions, also highlights the challenge of overcoming ingrained cognitive biases during the process.

Further Reading

[Problem solving \(Wikipedia\)](#)

[Cognitive psychology \(Wikipedia\)](#)

[Win-stay, lose-shift strategy \(Wikipedia\)](#)

[General Problem Solver \(Wikipedia\)](#)