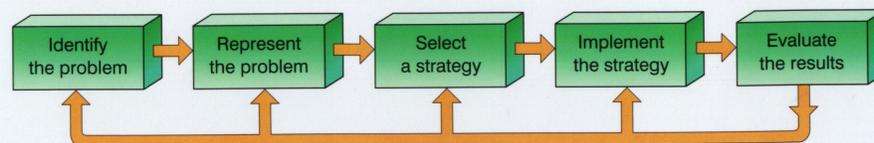


Problem Solving

General Problem-Solving Model



Identifying the Problem:

- **People are not in the habit of problem finding**
- **Enough background knowledge?**
- **People tend to be impulsive and not reflect on the nature of the problem**
- **Convergent vs. Divergent thinking**

Well versus Ill-Defined

Ill-Defined

- **Desired goal unclear**
- **Information missing**
- **Several possible solutions**

Well-Defined

- **Goal clearly stated**
- **All information present**
- **Only one correct solution**

Representing the Problem:

- **Consider external representations to relieve demands upon working memory and organize information (e.g. pictures, diagrams, charts)**
- **Experts spend proportionately more time at this stage than novices**

Selecting Strategies:

Algorithm

- **Exhaustive**
- **Solution guaranteed**

Heuristic

- **Rules-of-thumb**
- **Efficient**
- **Solution not guaranteed**
- **Examples**
 - **Trial & Error**
 - **Means End Analysis**
 - **Analogy**
 - **Working Backwards**

Implementing the Strategy:

- **Experts utilize more strategies (strategy shifting), consider more solutions, and evaluate solutions at a deeper level**

Convergent Thinking

- **Focus on one solution**

Divergent Thinking

- **Consider novel solutions**

Functional Fixedness

A condition that arises when we lose the ability to view familiar objects in a novel way

What is creativity?

“Ability to produce work that is both novel and appropriate“
(Sternberg & Lubart, 1996)

“The capacity to perform mental work that leads to an outcome both novel and applicable.” (Pereira, 1999)

NOVEL -> original, unexpected

– => **Associative thinking – recombine existing knowledge with divergent approaches**

PRODUCTIVE -> appropriate, applicable, useful, meets task constraints, has a contribution

– => **Critical thinking – What you select out, focus on**

Fostering Creativity

- Show students that creativity is valued
- Focus on internal rewards
- Promote mastery of subject area
- Ask thought-provoking questions
- Encourage metacognitive strategies that support creative thinking
- Give students freedom, security to take risks

Evaluating the Results:

- **The chance to improve problem-solving skills rests at this stage and is very metacognitive in nature**
- **Teachers who are “reflective practitioners” spend more time at this stage**
- **The development of self-regulatory skills is dependent upon evaluation**

Implications for Effective Learners:

- **Effective learners are flexible problem solvers, they toggle between strategies, and think divergently**
- **Help learners develop skills in representing problems**
- **Teach general strategies (e.g. draw out the problem, take your time, consider many different strategies to solve the problem, utilize background knowledge)**
- **Think divergently, see outside of your mental set**

Improving Learner Problem Solving

- **Improve background knowledge**
- **Build self-efficacy through practice**
- **Utilize social-interaction (learn strategies through others)**
- **Provide scaffolding (hints at critical junctures)**
- **Teach general strategies (e.g. draw out the problem, take your time, consider many different strategies to solve the problem, utilize background knowledge)**

Transfer of Learning

- **Occurs when something learned at one time and place is applied in another setting**
 - **Transferring to another university**
 - Schedule time with advisor
 - Knowing how to register for classes
 - Where to find information--library
- **Most difficult challenge for teachers!**
- **People often don't realize the relevance of their prior knowledge in new situations**
- **Important to instill a "disposition for transfer" in your students**
- **Need to reduce inert knowledge**

Factors Affecting Transfer

- **Structured practice that promotes automated problem solving increases transfer**
- **Meaningful learning leads to greater transfer than rote learning**
- **Relate problem-solving skills in one domain to another by the use of analogy. Students should see material as context-free rather than context-bound**
- **Give numerous worked-out examples**
- **Similarity between two situations increases transfer**
- **Transfer is more likely when only a short amount of time has elapsed after students have studied a topic**

The Acquisition of Expert Performance K. Anders Ericsson (1996)

- Ericsson is a strong proponent of environmental factors as mechanisms for the development of expertise.
- “The prospects of a general theory of expert performance are based on the assumption that the highly diverse forms of superior performance can be theoretically explained by a limited number of general mechanisms.” (p.14)
- Ericsson supports the “10 year rule”

The Role of Deliberate Practice

“... most effective learning requires a well-defined task with an appropriate difficulty level for the particular individual, informative feedback, and opportunities for repetition and corrections of errors.” (Ericsson, Krampe, & Tesch-Romer,1993)

- Improvement comes with increased practice regardless of initial talent/ability.
- Initial differences attributable to talent/ability (*g*) decrease over time as a function of practice.
- Quality not just quantity of practice is important.

Can only really smart people become experts at anything?

General Intelligence

General ability typically measured via standardized tests. Moderate to high predictor of ability for novel tasks.

Domain Specific Knowledge

Knowledge that individuals have about a particular field of study. High predictor of expertise in a given area.

Seven Characteristics of *Experts*

- 1. Experts excel only in their own domain.**
- 2. Experts process information in large units.**
- 3. Experts are faster than novices.**
- 4. Experts hold more information in short-term and long-term memory.**
- 5. Experts represent problems at deeper level.**
- 6. Experts spend more time analyzing a problem.**
- 7. Experts are better monitors of their performance.**