Learning Strategies to Develop and Assess Problem Solving and Reasoning Skills

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Explicit Instruction for a Cognitive Process

Original findings from university settings:

What’s the difference between the scholastically successful and unsuccessful university students when they think aloud?

1950’s Benjamin Bloom and Lois Broder, The University of Chicago

“Unsuccessful students were mentally careless and superficial in solving problems. They often rushed through a problem and selected a wrong answer because they failed to comprehend what was required.”

Arthur Whimbey, 1980
Why study reasoning?

“To study reasoning is to study intelligence, and vice versa. One cannot study the one without studying the other.”


*Intelligence Can Be Taught* - Think Aloud Paired Problem Solving approach designed for university (TAPPS)

Arthur Whimbey (1975); Arthur Whimbey and Jack Lochhead (1979)

Implemented by McMaster University, Hamilton, Ontario, Canada

Implemented by Xavier University, New Orleans, LA, USA

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Xavier’s Accomplishments

A Prescription for More Black Doctors

How does tiny Xavier University in New Orleans manage to send more African-American students to medical school than any other college in the country?


Xavier is also first in the nation in graduating black students with bachelor’s degrees in biology and physics. It is among the top four institutions graduating black pharmacists. It is third in the nation in black graduates who go on to earn doctorates in science and engineering.
Teaching Effective Thinking at McMaster

The McMaster University PBL Project underpins the engineering program

McMaster’s engineering program is consistently ranked in the top ten of Canada

Problem-based-learning (PBL), Designed by Donald Woods and pioneered at McMaster, has now spread across North America as a preferred method of instructing undergraduate students.
Problem Solving and Analytical Thinking

*Problem solving* is defined as a behavioral sequence, in a situation of defined parameters, which leads to a defined outcome as stated by an instructor, within a text or by the learner

- Distinguished from *analytical thinking*: a similar behavioral sequence, but involving a further element of inquiry and situations with less well-defined parameters and outcomes

*Analytical thinking* is necessary when an ambiguous situation requires the learner to identify or create a problem to solve
Reasoning – an element of problem solving and analytical thinking

*Reasoning*, an essential element of both problem solving and analytical thinking, involves the manipulation of verbal stimuli to restrict response alternatives in accord with a problem's outcome.

*Reasoning* is when the environment requires a learner to produce verbal stimuli that sequentially and systematically make one pattern of behavior more likely than another in order to meet a contingency requirement.

B.F. Skinner described an "inspection of reinforcement contingencies" such that behavior can be described that meets contingency requirements without direct contingency shaping or rules.
Reasoning Aloud in the Natural Environment: Why Children Talk to Themselves

“**Private speech** enables all children to direct their own behavior, acquire new skills and otherwise work through situations that are unfamiliar to them. When any child encounters a new task, he or she will state out loud those features of the problem that seem puzzling. As the youngster’s competence grows, this private speech turns into inaudible muttering. Finally, when the cognitive operations necessary to succeed at that task are well practiced, the child thinks words silently.”

Laura Berk
Scientific American, November 1994
Instruction Designed for Young Learners

Learn to Reason with TAPS: A Talk Aloud Problem Solving Approach
J.K. Robbins, 2014
www.talkaloudproblemsolving.com
Learn to Reason with TAPS: a Talk Aloud Problem Solving Approach
© Joanne K. Robbins, Ph.D. 2014

This video is part of an instructional package available for purchase from P.E.E.R. International.

Proceeds of the purchase of this material benefit teachers and learners in several township schools in South Africa.

Please see our website at www.peerinternational.org for further information.

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Establishing TAPS

Problem Solver
Active Listener

Phases of developing repertoires rather than a more “convenient” set of subskills to measure and ...

“The ability to coordinate the skills is more difficult to master than the subskills and, as a result, takes longer to achieve.”

Charles, Lester, Odaffer 1987
Monitor Progress: Curriculum *and* Instruction

Use curriculum that gets progressively more difficult.

Nature of TAPS is to present increasingly difficult problems.

TAPS is used as it will be in the natural environment—when a problem to be solved *requires* a strategy.

Create a bank of problems to solve: take into account growth in reading, writing tool skill, math skills in order to present appropriate level of challenge, a CBM approach.

Use and monitor Active Response Cards learners: observe demonstrations and identify instances of the various qualities.
Coordinating TAPS Qualities: Active Listener with Problem Solver

When the behavior of the Problem Solver is absent or off-track, the Active Listener will

- Demonstrate checking for accuracy
- Stay with the Problem Solver
- Catch mistakes
- Lead partner to the information and not give away the correct answer
- Use encouraging words to keep the Problem Solver talking aloud and generally being active

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Coordinating TAPS Qualities: Problem Solver with Active Listener

In the presence of a challenging problem and a requirement to solve that problem, the Problem Solver

Continuously demonstrates a positive attitude (approach tendencies)
Considers corrective feedback from the Active Listener
Breaks the problem into parts
Answers with confidence (avoid guessing)
Works actively by talking, marking, etc.
How to Monitor Progress?

Pretest and Posttests based upon Whimbey's WASI Whimbey's Analytical Skills Inventory

TAPS Observation Sheet used with trios of learners and PS and AL pairs with teacher observing
Note missing qualities and their acquisition, note Observation skills

Progress monitoring must be teacher-friendly
Progress monitoring must facilitate improvement in reasoning skills

Are the goals amenable to assessment, for example perseverance (endurance); positive attitude (approach tendencies)
# Simple Tool to Record Observations of Reasoning

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<th>Problem Solver</th>
<th>Active Listener</th>
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**Note:** The table above illustrates a Talk Aloud Problem Solving Approach with Problem Solvers and Active Listeners. Each entry includes visual representations and annotations.
Thank You!

What follows are references to the university programs mentioned here

Transcript of the dialogue between Problem Solver and Active Listener in the video available by email:

joanne@peerinternational.org
Xavier University, New Orleans
Project SOAR Publications


Xavier University, New Orleans
Project SOAR Publications


Xavier University, New Orleans

Project SOAR Publications


Below are some citations for papers we wrote when we expanded SOAR to SOAR 3 for computer science students.


Xavier University, New Orleans
Project SOAR Publications

Citations for papers SOAR expanded to SOAR 3 for computer science students.
McMaster Problem Based Learning


Instructional program available online: http://chemeng.mcmaster.ca/mcmaster-problem-solving-mps-program