From Technology-Rich Environments to Adaptive Problem Solving – Concept and Measurement

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Samuel Greiff & Juliana Gottschling - University of Luxembourg
Relevance of Adaptive Problem Solving

Relevance of Adaptive Problem Solving

Challenges and Impasses

Opportunities

Managing Resources

Constant Monitoring

Adapting Strategies
Definition of Adaptive Problem Solving

Adaptive problem solving involves the capacity to achieve one’s goals in a dynamic situation, in which a method for solution is not immediately available. It requires engaging in cognitive and metacognitive processes to define the problem, search for information, and apply a solution in a variety of information environments and contexts.

Greiff et al., 2021
Relevance of Adaptive Problem Solving

Cognitive Skills

Metacognitive Skills

APS
INTERNAL WORLD

Cognitive processes
- Selecting, organizing, and integrating information into mental model
- Retrieving relevant background information
- Externalizing internal problem representation

Metacognitive processes
- Goal setting
- Monitoring problem comprehension

Externalizing internal problem representation
- Searching for operators in the (mind and) environment
- Evaluating operators with respect to how well they satisfy problem constraints
- Executing operators

APPLICATION
- Monitoring progress
- Regulating the application
- Reflection

INFORMATION ENVIRONMENT (PHYSICAL, SOCIAL, DIGITAL)

Greiff et al., 2021; adapted from Greiff et al., 2017, p. 19
Cognitive Processes in APS

Defining

Selecting, organizing, and integration into mental model

Constructing a mental representation of the problem space (initial state, goal state, legal operators)
Cognitive Processes in APS

Defining

- Selecting, organizing, and integration into mental model
- Retrieving relevant background information
- Accessing memory to retrieve background knowledge
Cognitive Processes in APS

Defining

- Selecting, organizing, and integration into mental model
- Retrieving relevant background information
- **Externalizing internal problem representation**

Creating an external representation (e.g., drawing, table) that illustrates the problem solver’s mental model of the problem
Cognitive Processes in APS

Searching

Searching for operators in the mind and environment

Locating information about available action options that might be suited to solve the problem
Cognitive Processes in APS

Searching

- Searching for operators in the mind and environment
- Evaluating operators with respect to how well they satisfy problem constraints

Determining which of the action options will be best to reach the goal while considering all possible constraints.
Cognitive Processes in APS

Application

Applying plans and executing operators

Implementing the selected operator(s) to solve the problem
Cognitive Processes in APS

**Defining**
- Selecting, organizing, and integration into mental model
- Retrieving relevant background information
- Externalizing internal problem representation

**Searching**
- Searching for operators in the mind and environment
- Evaluating operators with respect to how well they satisfy problem constraints

**Application**
- Applying plans and executing operators
Metacognitive Processes in APS

Defining

Goal setting

Deciding upon what the to-be-achieved state is about
Metacognitive Processes in APS

Defining

Goal setting

Monitoring problem comprehension

Supervising whether one’s mental model of the problem matches the current state of affairs
Metacognitive Processes in APS

Searching

- Evaluating operators with respect to whether they can be executed
- Determining which of the action options will be best to reach the goal while considering all possible constraints
Metacognitive Processes in APS

**Application**

- Monitoring progress
- Determining whether executing operators achieves the desired outcome
Metacognitive Processes in APS

**Application**

- Monitoring progress
- **Regulating application of operators**

Modifying selection of operators in case the problem configuration has changed (cf. monitoring problem comprehension) or impasses have been noted (cf. monitoring progress)
Metacognitive Processes in APS

**Application**

- Monitoring progress
- Regulating application of operators

**Reflection**

Deliberating about one's own capabilities to solve problems with the goal of abstracting knowledge from it that can be applied in the future
Metacognitive Processes in APS

Defining
- Goal setting
- Monitoring problem comprehension

Searching
- Evaluating operators with respect to whether they can be executed

Application
- Monitoring progress
- Regulating application of operators
- Reflection
Dinner Preparation - Question 1 / 2

Look at the map and the sticky note. Follow the instructions shown and tap on the destinations to complete the task below.

It’s 8 o’clock in the morning. You need to take your child to school by 8:30 a.m. and go to a shop to buy the ingredients for dinner. You need to be back home by 10:00 a.m.

Plan the fastest route to accomplish these goals. Keep the time constraints in mind.

After you drew the route to the first destination, tap on Apply to continue with the planning. The driving time will update.

- Bring child to school by 8:30 a.m.
- Buy ingredients for dinner
- Be back home by 10:00 a.m.
Dinner Preparation - Question 2 / 2

Look at the map and the sticky note. Follow the instructions shown and tap on the destinations to complete the task below.

You have planned the route to accomplish all of your goals for the day as shown on the map. It is now 8:30 and you already brought your child to school. You are about to leave to your next planned destination when you receive a news alert that your chosen shop has been closed due to a water leakage.

Adapt your chosen route to accomplish the rest of your goals for the day. Keep the time constraints in mind.

- Bring child to school by 8:30 a.m.
- Buy ingredients for dinner
- Be back home by 10:00 a.m.

Total driving time: 50 min

Taken from OECD framework on PIAAC APS
### PIAAC

**Stock Market - Question 1 / 2**

Look at the information about your investments and performance of companies in which you own stock. Tap on "+" or "-" in the table to answer the question below.

**Based on the information provided, which shares should you buy or sell in order to maximize your chance for higher profits next day?**

Tap on "+" to buy or "-" to sell shares in one or more of the companies in the table below.

**Your Stock Portfolio**

<table>
<thead>
<tr>
<th>Company</th>
<th>Shares held</th>
<th>Current price per share</th>
<th>Total in stock</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>20</td>
<td>2.50 Zeds</td>
<td>50.00</td>
</tr>
<tr>
<td>2</td>
<td>4</td>
<td>3.00 Zeds</td>
<td>12.00</td>
</tr>
<tr>
<td>3</td>
<td>6</td>
<td>6.00 Zeds</td>
<td>36.00</td>
</tr>
<tr>
<td>4</td>
<td>15</td>
<td>1.25 Zeds</td>
<td>18.75</td>
</tr>
<tr>
<td>5</td>
<td>10</td>
<td>3.00 Zeds</td>
<td>30.00</td>
</tr>
<tr>
<td><strong>Total in Stock</strong></td>
<td></td>
<td></td>
<td><strong>146.75</strong></td>
</tr>
</tbody>
</table>

**Your Investments**

<table>
<thead>
<tr>
<th>Total money to invest</th>
<th>Total money in stocks</th>
<th>Disposable cash to invest</th>
</tr>
</thead>
<tbody>
<tr>
<td>200</td>
<td>146.75</td>
<td>+ 53.25</td>
</tr>
</tbody>
</table>

**Stock Performance over the Past Five Days**

<table>
<thead>
<tr>
<th>Company</th>
<th>Day 1</th>
<th>Day 2</th>
<th>Day 3</th>
<th>Day 4</th>
<th>Day 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>+2.00%</td>
<td>-1.25%</td>
<td>+0.25%</td>
<td>-0.50%</td>
<td>-0.50%</td>
</tr>
<tr>
<td>2</td>
<td>+0.10%</td>
<td>+0.10%</td>
<td>+0.10%</td>
<td>+0.10%</td>
<td>+0.10%</td>
</tr>
<tr>
<td>3</td>
<td>+0.10%</td>
<td>+0.10%</td>
<td>+0.10%</td>
<td>+0.10%</td>
<td>+0.10%</td>
</tr>
<tr>
<td>4</td>
<td>-0.50%</td>
<td>-1.25%</td>
<td>-0.75%</td>
<td>-1.50%</td>
<td>-1.25%</td>
</tr>
<tr>
<td>5</td>
<td>+0.50%</td>
<td>-1.50%</td>
<td>-0.25%</td>
<td>+0.10%</td>
<td>-1.55%</td>
</tr>
</tbody>
</table>

Taken from OECD framework on PIAAC APS
PIAAC

Stock Market - Question 2 / 2

Look at the information about your investments and performance of companies in which you own stock. Tap on "+" or "-" in the table to answer the question below.

Based on the information provided, which shares should you buy or sell in order to maximize your chance for higher profits next day?

Tap on "+" to buy or "-" to sell shares in one or more of the companies in the table below.

<table>
<thead>
<tr>
<th>Shares owned now</th>
<th>buy</th>
<th>sell</th>
<th>Shares owned after Invest</th>
</tr>
</thead>
<tbody>
<tr>
<td>Company 1</td>
<td>0</td>
<td>+</td>
<td>-</td>
</tr>
<tr>
<td>Company 2</td>
<td>33</td>
<td>+</td>
<td>-</td>
</tr>
<tr>
<td>Company 3</td>
<td>48</td>
<td>+</td>
<td>-</td>
</tr>
<tr>
<td>Company 4</td>
<td>0</td>
<td>+</td>
<td>-</td>
</tr>
<tr>
<td>Company 5</td>
<td>0</td>
<td>+</td>
<td>-</td>
</tr>
</tbody>
</table>

Your Stock Portfolio

<table>
<thead>
<tr>
<th>Shares held</th>
<th>Current price per share</th>
<th>Total in stock</th>
</tr>
</thead>
<tbody>
<tr>
<td>Company 1</td>
<td>2.50 Zeds</td>
<td>0.00</td>
</tr>
<tr>
<td>Company 2</td>
<td>3.00 Zeds</td>
<td>99.00</td>
</tr>
<tr>
<td>Company 3</td>
<td>6.00 Zeds</td>
<td>288.00</td>
</tr>
<tr>
<td>Company 4</td>
<td>1.25 Zeds</td>
<td>0.00</td>
</tr>
<tr>
<td>Company 5</td>
<td>3.00 Zeds</td>
<td>0.00</td>
</tr>
</tbody>
</table>

Total in Stock: 387.00

Your Investments

<table>
<thead>
<tr>
<th>Total money to invest</th>
<th>Total money in stocks</th>
<th>Disposable cash to invest</th>
</tr>
</thead>
<tbody>
<tr>
<td>400</td>
<td>387.00</td>
<td>-13.00</td>
</tr>
</tbody>
</table>

Stock Performance over the Past Five Days

<table>
<thead>
<tr>
<th>today</th>
<th>day-1</th>
<th>day-2</th>
<th>day-3</th>
<th>day-4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Company 1</td>
<td>+0.00%</td>
<td>-0.25%</td>
<td>+3.25%</td>
<td>+0.75%</td>
</tr>
<tr>
<td>Company 2</td>
<td>-0.40%</td>
<td>+0.50%</td>
<td>+0.10%</td>
<td>-0.10%</td>
</tr>
<tr>
<td>Company 3</td>
<td>-0.30%</td>
<td>+0.25%</td>
<td>+0.30%</td>
<td>+0.10%</td>
</tr>
<tr>
<td>Company 4</td>
<td>-0.00%</td>
<td>-0.25%</td>
<td>-0.10%</td>
<td>+2.25%</td>
</tr>
<tr>
<td>Company 5</td>
<td>+0.00%</td>
<td>+0.25%</td>
<td>-0.25%</td>
<td>-0.50%</td>
</tr>
</tbody>
</table>

Taken from OECD framework on PIAAC APS
Thank you!

Q & As

samuel.greiff@uni.lu