PSTRE Background Information

This document contains excerpts selected by David J. Rosen from the *OECD Technical Report of the Survey of Adult Skills (PIACC)* that describe PSTRE skills. We hope it will help in understanding these skills and their complexity, and how they are measured. The first seven pages describe the PSTRE domain, and the remaining three pages include samples of items at each of three levels.

The PSTRE domain of PIAAC covers the specific class of problems people deal with when using information and computer technology (ICT). These problems share the following characteristics:
• The existence of the problem is primarily a consequence of the availability of new technologies.
• The solution to the problem requires the use of computer-based artifacts (applications, representational formats, computational procedures).
• The problems are related to the handling and maintenance of technology-rich environments themselves (e.g., how to operate a computer, how to fix a settings problem, how to use the Internet browser in a technical sense).

PSTRE represents a domain of competence which involves the intersection of the set of skills that are sometimes described as "computer literacy" (i.e., the capacity to use ICT tools and applications) and the cognitive skills required to solve problems. Some knowledge of how to use basic ICT input devices (e.g., use of a keyboard and mouse and screen displays), file management tools, applications (word processing, email) and graphic interfaces is essential in order to be able undertake assessment tasks. However, the objective is not to test the use of ICT tools and applications in isolation, but rather to assess the capacity of adults to use these tools to access, process, evaluate and analyze information effectively.
Survey of Adult Skills Technical Report, Foreward, Page 4, online page 8.
http://www.oecd.org/site/piaac/_Technical%20Report_17OCT13.pdf

Literacy, numeracy and PSTRE constitute a subset of the skills and competencies that are demanded in the labor market and mediate access to resources and services more generally in society.
Foreword, Page 4, online page 8

The domain of numeracy remains largely unchanged between ALL and PIAAC. PSTRE constitutes a new domain. While it has some relationship to

problem solving as conceived in ALL, the emphasis is on the skills necessary to solve "information problems" and the solution of problems in an ICT context rather than on analytic problem skills per se.
Foreword, Page 15, online page 19

PIAAC also included a new domain: problem solving in technology-rich environments (PSTRE). This was the first attempt to assess such a construct on a large scale and as a single dimension. PSTRE included computer-based simulation tasks designed to measure the ability to analyze various requirements of a task, define goals and plans, and monitor progress until task purposes were achieved. The focus was not on computer skills per se, but rather on the cognitive skills required to access and make use of computer-based information to solve problems.
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2.2.3 Problem solving in technology-rich environments (PSTRE)

2.2.3.1 Definition of the domain
PSTRE was broadly defined as using digital technology, communication tools and networks to acquire and evaluate information, communicate with others and perform practical tasks.

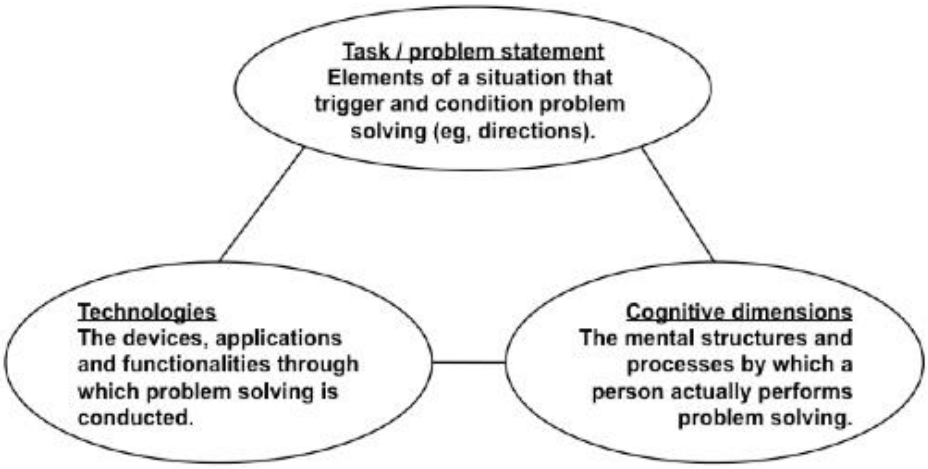
PIAAC represented the first attempt to assess PSTRE on a large scale and as a single dimension. This presented challenges in terms of the definition of tasks and the practical collection of data. Furthermore, digital technologies continue to evolve at a rapid pace, as do the personal, social and work-related uses of these technologies. While setting the stage for further rounds of assessment, the framework took into consideration issues of feasibility as well as the evolution of technology and its uses. In light of these challenges and constraints, the definition went on to further specify the scope of this first assessment of PSTRE for PIAAC:

The first PIAAC problem-solving survey focuses on the abilities to solve problems for personal, work and civic purposes by setting up appropriate goals and plans, and accessing and making use of information through computers and computer networks.

2.2.3.2 Core dimensions of problem solving in technology-rich environments

The domain of PSTRE was conceived along three dimensions, as shown in Figure 2.1.

Figure 2.1: Core dimensions of problem solving in technology-rich environments



"Cognitive dimensions" include the mental structures and processes involved when a person solves a problem. These include setting goals and monitoring progress; planning; accessing and evaluating information; and making use of information by selecting, organizing and transforming information.

"Technologies" are the devices, applications and functionalities through which problem solving is conducted. These include hardware devices (laptop computers in the case of PIAAC); simulated software applications; commands and functions; and representations (text, graphics, etc.).

"Tasks" are the circumstances that trigger a person's awareness and understanding of the problem and determine the actions needed to be taken in order to solve the problem. Ordinarily, a wide range of conditions can initiate problem solving. For instance, a computer user may realize that his or her mailbox is crowded and that a new schema is needed for classifying emails. Alternatively, he or she may be faced with a complex issue (such as finding out more about a medical treatment) and decide to look for relevant information on the Web. In test-taking contexts, tasks are more explicitly assigned to respondents. *They include the question and task instructions presented to respondents, as well as the specific materials and time constraints associated with the test.*

Dimensions of the tasks being assessed in PIAAC PSTRE included:
• Task purposes and contexts, including personal, work/occupation, and civic

• The intrinsic complexity of the problem
Intrinsic complexity is related to a set of more specific variables: the minimum number of steps or actions required to solve the problem; the number of options at each phase; the diversity of operators and the complexity of mental reasoning and/or computation; the probability of impasses or unexpected outcomes; the number of constraints to be satisfied; and the amount of composition or transformation needed to communicate a solution.

• The explicitness of the problem statement and task directions given to the respondent
This dimension ranges from well-defined, explicit problem statements to implicit and ill-defined problem statements. A problem situation that requires the respondent to select operators and subgoals or define the successful achievement of a goal makes the problem more difficult.

2.2.3.3 PSTRE in relation to other domains of PIAAC
The constructs of literacy, numeracy and PSTRE rely on the same "core" cognitive processes. For example, tasks in all three domains require both an ability to decode printed symbols and a minimal working memory capacity. PSTRE also assessed a set of competencies distinct from those defined in the other two constructs

The assessment of PSTRE in PIAAC focused on goal setting, monitoring and planning in technology-rich environments, and assessment tasks emphasized the problem-finding and problem-shaping processes typically found in these environments. Tasks included selecting an appropriate software application; deciding on one among several possible strategies; making use of adequate functionalities in a context-sensitive manner; interpreting ill-structured texts; and using online forms.

Respondents needed to complete problem-solving tasks in environments that involved multiple and complex sources of information. Some of the tasks required respondents to use and shift across multiple environments. PSTRE therefore assessed decision making with respect to the use of information sources (for example, choosing which environment to use or deciding whether or not to go to another website.) Evaluation was included as a critical underlying part of problem solving. Additionally, the selection of appropriate devices or tools took a prominent role in this domain.

In terms of processing information, problem solving is a specific construct in that it focuses on:

• the evaluation of sources in terms of reliability and the adequacy of information relative to the problem statement, as opposed to mere topical relevance, which is more applicable for literacy

• the integration of information across sources, especially in cases where the sources provide inconsistent information

PSTRE tasks sought to minimize the numeracy and literacy demands placed on respondents in order to increase the specificity and validity of the construct.

2.2.3.4 PSTRE and ICT competence
What differentiates the problem-solving domain from the general ICT domain? ICT skills may be broadly defined as "the interest, attitude, and ability of individuals to appropriately use digital technology and communication tools" (Lennon, et al., 2003). As is true for literacy and numeracy skills, ICT skills underlie PSTRE. However, the PSTRE construct aimed to encompass more than the purely instrumental skills related to the knowledge and use of digital technologies. The cognitive dimensions of problem solving were considered the central object of the assessment, with the use of ICT as secondary.
Chapter 2, pages 9 -12, online pages 52-55

The assessment of PSTRE involved scenarios of varying complexity and length, designed to take between five and 15 minutes to complete. Overall, 14 units were used in the Field Test. Several of those units included multiple parts, or tasks, so a total of 24 tasks were included. Two 25-minute blocks were included in the Main Study. Block 1 had five units, with seven associated tasks, and Block 2 had six units, also with seven tasks.
Chapter 2, page 15, online page 58

Tasks for PSTRE were situated in simulated computer environments including a browser, email system, spreadsheet and word processor. While these did not replicate the full functionality of real-life environments, they included many key functions. For example, the email environment allowed respondents to reply, reply to all, forward, send and move emails to folders. In the browser environment, respondents could navigate using the back, forward and home buttons and they could bookmark pages for later reference. Presenting the PSTRE tasks in these simulation environments allowed the computer to capture a variety of process information. For any given task, collected information included

time spent, actions taken (e.g., clicking and typing responses or selections from drop-down menus such as "file" and "edit") and the sequence in which actions were completed. This information provided direct evidence of the processes and strategies respondents used to complete assigned tasks and therefore allowed for better inferences about their knowledge and skills related to PSTRE.
Chapter 2, page 18, online page 61

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Table 2.11: Distribution of PSTRE tasks by cognitive dimensions

	Number*
Setting goals and monitoring progress	4
Planning	7
Acquiring and evaluating information	8
Using information	6

*Some tasks address more than one cognitive dimension so total is more than 14

Table 2.12: Distribution of PSTRE tasks by technology dimension

	Number*
Web	7
Spreadsheet	4
Email	9

*Some tasks involve more than one technology environment so total is more than 14

Table 2.13: Distribution of PSTRE tasks by context

	Number
Personal	8
Work/Occupation	4
Civic	2

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21.3.3 Problem solving in technology-rich environments

The PSTRE domain is organized around three core dimensions: the cognitive strategies and processes a person uses to solve a problem, the tasks or problem statements that trigger and condition problem solving, and the technologies through which the problem solving is conducted. Variations within and across all of those dimensions were expected to contribute to the overall difficulty of the problems presented in the PIAAC assessment. For example, a problem is likely to be more complex if it is ill-defined as opposed to explicitly stated, if it requires complex problem solving strategies such as defining goals and resolving impasses,

and/or if it requires the use of multiple technology environments (e.g., respondents must utilize both emails and spreadsheets).

In order to explain how proficiency can be affected by the three dimensions of PSTRE, the problem-solving proficiency scale was divided into three levels as shown below. In this section, we describe the essential features of tasks at each of these three levels.

Table 21.1: Technology, task and cognitive characteristics of problems at each of three main levels of proficiency

Level	Technology features	Task features	Cognitive processes
Level 1	• Generic applications • Little or no navigation required • Relevant information is directly available • Use of facilitating tools not required	• Few steps • Single operators	• Reach a given goal • Apply explicit criteria • Minimal monitoring demands • Simple relevance match • Categorical reasoning • No integrate or transformation
Level 2	• Both generic and novel applications (e.g., Web-based services) • Some navigation required to acquire information or perform actions • Use of tools facilitates operations	• Multiple steps • Multiple operators	• Goal may need to be defined • Apply explicit criteria • Generally higher monitoring demands • Generally involves resolving impasses • Some evaluation of relevance • Some integrate or transformation • Inferential reasoning
Level 3	• Generic and novel applications • Some navigation required to acquire information or perform actions • Use of tools required to efficiently solve the problem	• Multiple steps • Multiple operators	• Goal may need to be defined • Establish and apply criteria • Generally high monitoring • High inferential reasoning and integration • Evaluate relevance and reliability • Generally involves resolving impasses

Examples

PSTRE Level 1 ***241 to 290***

At this level, tasks typically require the use of widely available and familiar technology applications, such as email software or a Web browser. There is little or no navigation required to access the information or commands required to solve the problem. The problem may be solved regardless of one's awareness and use of specific tools and functions (e.g., a sort function). The task involves few steps and a minimal number of operators. At a cognitive level, the person can readily infer the goal from the task statement; problem resolution requires one to apply explicit criteria; there are few monitoring demands (e.g., the person does not have to check whether he or she has used the adequate procedure or made progress toward the solution). Identifying contents and operators can be done through simple match; only simple forms of reasoning, for example, assigning items to categories are required. There is no need to contrast or integrate information.

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Level 1 Sample Problem

Party Invitations (U01A)
Difficulty: 286

This task presents a problem where respondents are asked to organize a set of email responses they had received in response to a party invitation. The necessary folders are present in the email environment; respondents need to sort a set of emails into those existing folders. The email interface is presented with five emails in an inbox and the respondent is asked to organize the responses to keep track of who can and cannot attend the party. In terms of the three PSTRE dimensions, the item requires the respondent to categorize a small number of messages in an email application in existing folders according to a single criterion. This is typical of a Level 1 item because the goal is explicitly stated in operational terms, the task is performed in a single environment, and it can be solved in a relatively small number of steps using a restricted range of operators. Thus, the task does not require the user to learn a novel environment, nor does it necessitate a significant amount of monitoring across a large number of actions.

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PSTRE Level 2 ***291 to 340***

At this level, tasks typically require the use of both generic and more specific technology applications. For instance, the person may have to make use of a novel online form. Some navigation across pages and applications is required to solve the problem. The use of tools (e.g., a sort function) can facilitate the

resolution of the problem. The task may involve multiple steps and operators. In terms of cognitive processing, the problem goal may have to be defined by the person, though the criteria to be met are explicit. There are higher monitoring demands. Some unexpected outcomes or impasses may appear. The task may require evaluating the relevance of a set of items to discard distractors. Some integration and inferential reasoning may be needed.
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Level 2 Sample Problem

Club Membership (U19B)
Difficulty: 296
This task consists of responding to an information request and demands locating information in a spreadsheet. Respondents must identify an undefined number of members of a biking club who meet the provided eligibility requirements to serve as club president. The information can most efficiently be located within the long spreadsheet by using a sort function. The respondent is presented with two environments: a word processor page containing information about the two conditions required for club presidents, and a database with 200 entries where the relevant information can be found. In terms of the three PSTRE dimensions, the item requires the respondent to organize large amounts of information in a multiple column spreadsheet using multiple explicit criteria and locate and mark relevant entries. This is typical of Level 2 because the task requires switching between two different applications and involves multiple steps and operators. It also requires some amount of monitoring. Making use of the available tools (e.g., the sort function) greatly facilitates the identification of the relevant entries.
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PSTRE Level 3 ***341 to 500***
At this level, tasks typically require the use of both generic and more specific technology applications. Some navigation across pages and applications is required to solve the problem. The use of tools (e.g., a sort function) is required to make progress toward the solution. The task may involve multiple steps and operators. In terms of cognitive processing, the problem goal may have to be defined by the person, and the criteria to be met may or may not be explicit. There are typically high monitoring demands. Unexpected outcomes and impasses are likely to occur. The task may require evaluating the relevance and the reliability of information in order to discard distractors. Integration and inferential reasoning may be needed to a large extent.
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Level 3 Sample Problem

Meeting Rooms (U02)

Difficulty: 346

This task requires respondents to check a number of email requests regarding reservations for a meeting room on a particular date and schedule those reservations based on multiple constraints (including the number of rooms available and reservations already made). Impasses due to conflicting constraints have to be resolved by initiating a new subgoal, that is, issuing a standard message to decline one of the requests. Two environments are present: an email interface with a number of emails containing the requests for meeting dates and times, and a novel Web application that allows respondents to assign rooms to meetings at certain times. Upon discovering that one of the requests cannot be accommodated, the respondent has to use a specific command on the website in order to issue a standard message declining the request. In terms of the three PSTRE dimension, the item requires the respondent to use information from a novel Web application and several email messages, establish and apply criteria to solve a scheduling problem where an impasse must be resolved, and communicate the outcome. This is typical of Level 3 as the task involves multiple applications, a large number of steps, a built-in impasse, and requires the respondent to discover and use ad hoc commands in a novel environment. The respondent has to set up and monitor the application of a plan in order to minimize the number of conflicts. Furthermore, the respondent has to transfer information from one application (email) to another (room reservation).

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