Chapter 27
Assessing Problem Solving in Technology-Rich Environments: What Can We Learn from Online Strategy Indicators?

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ABSTRACT

The spread of digital information system has promoted new ways of performing activities, whereby laypersons make use of computer applications in order to achieve their goal through the use of problem solving strategies. These new forms of problem solving rely on a range of skills whose accurate assessment is key to the development of postindustrial economies. In this chapter, we outline a definition of problem solving in technology-rich environment drawn from the OECD PIAAC survey of adult skills. Then we review research studies aimed at defining and using online indicators of PS-TRE proficiency. Finally, we present a case study of one item that was part of the PIAAC PS-TRE assessment.

INTRODUCTION

The spread of digital information networks over the past decades has raised new societal challenges worldwide. An increasing number of everyday activities inside and outside the workplace can and sometimes must be performed through a computer and an Internet connection. Such activities might include online shopping or banking as well as accessing public services and information pertaining to various domains (health, law, regulations, and so forth).

Assuming they have access to computers and a connection to the Internet, do laypersons possess the skills needed to use these tools in order to fulfill their needs? What are the cognitive demands of

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problem solving in the context of digital technologies, and how can they be assessed? In this chapter we examine the use of online indicators of proficiency, based on the available research literature and on the study of adult skills conducted by the OECD (Program for the International Assessment of Adult Competencies, or PIAAC; OECD, 2013a; OECD, 2013b). The PIAAC study examined three domains of skills, namely reading literacy, numeracy, and problem solving in technology-rich environments (PS-TRE). In the first part of the chapter, we outline the conceptual underpinnings of the latter domain. Then we discuss the use of various types of online indicators. Finally, we present a case study of one of the items included in the PIAAC PS-TRE study, to illustrate the potential of simple and more complex indicators.

PROBLEM SOLVING IN TECHNOLOGY-RICH ENVIRONMENTS (PS-TRE)

People are said to face a problem whenever they cannot routinely fulfill their purposes. Problem solving has been a prominent subject of investigation in cognitive science ever since the advent of the "cognitivist" paradigm (e.g., Newell & Simon, 1972). Problem solving typically involves a series of cognitive steps and operations: One must understand the nature of the problem (i.e., "problem finding"; Getzels, 1979); plan a set of subgoals and actions that can lead to the resolution of the problem (or "problem shaping"); and unfold the plan until a solution is reached, unless an impasse or another obstacle forces them to reconsider their plans. Problem solving plays a central part in a large number of activities—from the simplest everyday issues, to schooling, to post-secondary training, to the most complex professional occupations. Accumulated experience, knowledge, and one's ability to articulate goals and plans are essential to successful problem solving (Chi, Glaser, & Rees, 1982 Funke, 2010; Mayer, 1992; Sweller, 1998).

Problems vary according to a number of dimensions. The openness of the problem space or the amount of information needed to come to a solution (a continuum sometimes construed as the "information-lean" vs. "information-rich" problem dichotomy) are two of the dimensions along which problems may vary. In recent decades, there has been a growing interest in problems that require people to make use of large amounts of information. The phrase "information problem solving" (Eisenberg & Berkowitz, 1990; Moore, 1995) was proposed to denote this category of problems. Brand-Gruwel, Wopereis, and Vermetten (2005) define information problems as "tasks or assignments that require [students] to identify information needs, locate corresponding information sources, extract and organize relevant information from each source, and synthesize information from a variety of sources." Early studies found that even simple information problems can be challenging for students from grade school (Kobasigawa, 1983; Moore, 1995; Rouet, 1990) to college and beyond (Brand-Gruwel, Wopereis, & Walraven, 2009; Rouet, Favart, Britt & Perfetti, 1997; see also Lazonder & Rouet, 2008).

Most activities involving the use of digital devices may qualify as information problem solving, since digital devices are primarily meant to support the production, dissemination, and access to various types of information. Digital environments require the use of specific tools, such as computer desktops and icons, e-mail systems, electronic text processing software, menu frames, index tables, search engines, and so forth. In general, software applications are operated by selecting functions in menus, clicking on specific icons or links displayed on a screen, using the scroll bar, or entering semantic information with the help of computer peripheries. Procedural knowledge of operating a keyboard and a mouse; opening up, moving, and closing windows; selecting and launching applications; as well as understanding computer features and functionalities are necessary to successfully interact with digital devices.