

Exploring Response Patterns in Problem-Solving Items Using Process Data: Insights from Log Files of Problem Solving in Technology-Rich Environments (PS-TRE) in PIAAC

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Focus: This paper draws on process data from log files recorded in the PIAAC problem solving in technology-rich environments (PSTRE) program to address the question of how sequences of actions recorded in problem-solving tasks are related to task performance. **We investigated the utility of behavioral process data for predicting differences in task performance.** More specifically, we separated the test takers into two performance groups (correct and incorrect) in one PSTRE item¹, extracted action sequences, and identified the key action sequences that were significantly associated with task completion.

Objectives: The purpose of this study is twofold: first, to extract and detect robust sequential action patterns that are associated with success or failure on a problem-solving item, and second, to compare the extracted sequence patterns among selected countries.

Methods: A total of 3,926 test takers from three exemplary countries (the United States, the Netherlands, and Japan), consisting of 2,754 individuals (70.1%) in the correct group and 1,172 (29.9%) in the incorrect group, were included in the study. Motivated by the methodologies of natural language processing and text mining, we disassembled the test takers' process data into small action sequences and applied feature selection models to identify the discriminant action sequence patterns by different performance groups at a variety of aggregate levels.

Results: The results showed that action sequence patterns significantly differed by performance groups and were consistent across countries. Among the robust indicators that we noticed were that the correct group had a better understanding of the sub-goals of different environments and were more likely to recover from initial errors in the problem-solving process. Conversely, respondents in the incorrect group appeared to have only a relatively vague idea about what was expected in the item and were more likely to show hesitant behaviors, such as clicking on the Cancel button multiple times and using the Help function.

Conclusion and Implications: In conclusion, with increasing use of computer-based assessments, process data play an increasingly important role in tracking test takers' thinking and action sequences. This pilot study presents what we think is a promising method to analyze process data and extract robust sequence features that are informative for differentiating between performance groups.

¹ Since the action sequences are special per problem solving item, we focused on one PSTRE item to illustrate how we tracked test takers' problem solving process using process data.