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Editorial: The use of organized learning models in assessment

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Editorial on the Research Topic
The use of organized learning models in assessment

In this editorial we posit that there is a growing recognition that educational achievement assessments can and must support student learning, that the assessment process can best support learning when it is based on an organized learning model, and that the most useful-to-learning organized learning models will include both models of learning and psychometric modeling. We end the editorial with a call for more research.

For most of its history, the focus of large-scale educational achievement testing was the assessment of learning. Starting with Scriven's (1967) differentiation between formative and summative evaluation, educational researchers and measurement experts started paying attention to formative assessment, more recently referred to as assessment ***for*** learning. This assessment purpose had long been the focus of classroom teachers and curriculum specialists but with little or none of the quantitative trappings of large-scale psychometrics.

The development of organized learning models—the ordered relationships among precursor, target, and successor skills—began at about the same time as the formalization of assessment for learning. For example, 60 years ago, Gagné et al. (1962) suggested that

> a class of human tasks to be learned (like solving linear equations, adding rational numbers) can be analyzed into a hierarchy of subordinate learning sets, which mediate positive transfer of learning in a unidirectional fashion from one to another, and ultimately to the final performance. (p. 1)

These ordered relationships can be displayed as a graphical model. These graphical models of learning structure have had many names: learning set hierarchies (Gagné and Paradise, 1961), cumulative learning sequences (Gagne, 1968), learning trajectories (Simon, 1995), learning progressions

(Alonzo and Steedle, 2009), progress maps (Masters and Forster, 1996), and learning maps (Kingston et al., 2016). Herein, we use the term organized learning model to refer to any and all of these models.

Thorndike (1918, p. 16), said, "Whatever exists at all exists in some amount. To know it thoroughly involves knowing its quantity as well as its quality." In line with this we believe that the structure of the most useful models that support learning should have both qualitative (description of learning targets and the pathways that indicate precursor, target, and successor relationships) and quantitative (statistical parameters that describe the conditional probability of mastery) aspects. Without the combination of these aspects in a single model, knowledge and thus usefulness will be limited. For example, it is more useful than not to know that for some pathways a students have a lower probability of success than for other pathways, and even more useful to know those probabilities might be conditioned on specific prior learning (or other variables). Such combined models allow assessments to support high quality inferences about what students know and can do and, thus, can help teachers personalize and optimize learning for individual students. This is because the graphical structure of the model combined with statistical models such as Bayesian network analysis (Almond et al., 2007) or diagnostic classification models (Rupp et al., 2010) improves the precision of measurement.

The National Council on Measurement in Education, a professional organization whose membership consists primarily of people focused on psychometrics and large-scale assessment, recognized that there was a need for enhanced dialog among assessment specialists focused on large-scale and classroom assessment and formed a committee and conference series to this end. The theme of the first conference was "Classroom assessment and large-scale psychometrics: Shall the twain meet?" (Heritage and Kingston, 2019). Many of the talks at that conference reflected recent advances in merging models of learning and psychometric models.

Despite a growing literature about organized learning models over the past two decades, many research questions remain regarding the use of organized learning models. A sampling of such questions follows.

- Are organized learning models useful for teachers and, if so, in what ways?
- Are different forms of organized learning models and/or their presentation more or less useful to teachers?
- Is there an optimal grain size for organized learning models and, if so, does it vary with purpose?
- Are intermediate structures—local neighborhoods of closely related nodes—useful to either the understanding or use of these models?
- How can models be constructed that represent the diversity of learners?
- Under what circumstances might the parameterization of these models be invariant within relevant populations?
- What are the best approaches to validating hypothesized learning models?

In addition, empirical evidence is needed that organized learning models can be used to help students learn better. Evidence accumulated from empirical work may also push forward theoretical development around organized learning models. Challenges in the use of organized learning models may generate innovative approaches to analyzing these models. We encourage more of our colleagues to work together on these issues, and especially for experts in curriculum, instruction, and student learning and psychometric modeling to work together in addressing these questions and formulating others.

Author contributions

NK drafted the editorial and resolved the comments of the other authors, however all authors made a significant intellectual contribution to this editorial.

Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Publisher's note

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