Psychometrics Help Learning: From Assessment to Learning

Applied Psychological Measurement

2018, Vol. 42(1) 3–4

© The Author(s) 2017

Reprints and permissions:

sagepub.com/journalsPermissions.nav

DOI: 10.1177/0146621617730393

journals.sagepub.com/home/apm

Yunxiao Chen¹ and Hua-Hua Chang²

Keywords

assessment, psychometrics, learning

Personalized learning refers to “instruction in which the pace of learning and the instructional approach are optimized for the needs of each learner. Learning objectives, instructional approaches, and instructional content (and its sequencing) may all vary based on learner needs,” according to the U.S. National Education Technology Plan 2017 (U.S. Department of Education, 2017) which provides a common vision and action plan that responds to an urgent national priority in education. This plan emphasizes the importance of personalized learning in future education and the associated new challenges to assessment. In recognizing this trend, this special issue of *Applied Psychological Measurement* brings together contributors’ expertise toward advances in psychometrics that facilitate learning. The specific materials contain a hidden Markov model for learning trajectories in cognitive diagnosis, a mathematical framework of recommendation system for adaptive learning, automatic item generation in computerized formative testing, application of support vector machine in cognitive diagnosis, a multilevel longitudinal nested logit model for analyzing the effect of an instructional intervention, and a brief report on application of cognitive diagnosis models in the Chinese classrooms for personalized learning.

Chen, Culpepper, Wang, and Douglas propose a class of cognitive diagnosis models for modeling learning trajectories, where learning is modeled by a hidden Markov process. The authors provide a discussion on the most general model as well as several assumptions that lead to greater parsimony and develop an Markov Chain Monte Carlo algorithm for parameter estimation. The proposed model is applied to a real data example of training spatial rotation skills with learning intervention.

Chen, Li, Liu, and Ying propose a mathematical framework of a personalized learning system that recommends the next material (video lectures, practices, and so on, on different skills) to the learner, based on the psychometric assessment results and possibly other individual characteristics. The proposed framework characterizes the recommendation process as a Markov decision problem, for which decisions are made based on the current knowledge of the learner and that of the learning materials. Two plain vanilla systems are introduced, for which the optimal recommendation at each stage can be obtained analytically.

¹Emory University, Atlanta, GA, USA

²University of Illinois at Urbana–Champaign, IL, USA

Corresponding Author:

Yunxiao Chen, Department of Psychology, and Institute for Quantitative Theory and Methods, Emory University, 36 Eagle Row #370, Atlanta, GA 30322, USA.

Email: yunxiao.chen@emory.edu

Gierl and Lai propose a new automatic item generation approach to generating both items and rationales required to solve the items as feedback for computerized formative testing. This approach addresses the problem of developing item banks for computerized formative testing, for which large numbers of diverse and high-quality items are required. This approach makes use of cognitive and psychometric modeling practices and is aided by computer technology. It is demonstrated in the medical education domain.

Liu and Cheng propose to use support vector machine, a popular supervised classification method in machine learning, for diagnosing students' mastery/nonmastery of attributes. The proposed method requires a training data set that contains classification results obtained from human raters. The method is computationally efficient and provides accurate classification result given a relatively small training sample. It therefore may complement the traditional calibration methods for cognitive diagnosis models and has the promise to be used in small-scale testing programs, such as classroom assessment.

Suh, Cho, and Bottge propose an item response theory model for analyzing the correct response and error types in multilevel longitudinal intervention data collected under a pretest–posttest, cluster randomized trial design. The proposed model is applied to data from a host study for comparing effects of two instructional conditions that involve participants from 24 urban and rural middle schools in the Southeastern United States. By presenting results based on the correct response and error probability comparisons, this method can provide practitioners with a detailed picture of the strengths and weaknesses of the intervention.

You, Li, Zhang, and Liu present a brief report on the operation of a cognitive diagnostic model–based assessment system in China, known as the Chinese Learning Diagnosis System. Key issues that have arisen in its development and application are discussed. By making use of cognitive diagnostic theory and assisted by Internet technology, the system has successfully integrated educational measurement into the teaching process and provides immediate feedback on learning and teaching.

Research articles in this issue provide methodological support to personalized learning and the brief report provides evidence on “psychometrics help learning” from the operational perspective, responding to the challenges and opportunities brought by technology-enabled personalized learning. By publishing these articles, we hope to (a) provide education researchers, learning scientists, and educators concrete psychometric models/methods for personalized learning and (b) draw the attention of psychometric researchers from the traditional summative assessment to formative assessment and its use in personalized learning.

Declaration of Conflicting Interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Funding

The author(s) disclosed receipt of the following financial support for the research, authorship, and/or publication of this article: This work was partially sponsored by NSF Grant SES-1632023 and a research grant from the Chinese Testing International Co., Ltd.

Reference

U.S. Department of Education. (2017). *Reimagining the role of technology in education: 2017 National Education Technology Plan update*. Retrieved from <https://tech.ed.gov/files/2017/01/NETP17.pdf>