

Julia Riebel · Hannah Lichtenberg

Formative Modelling in Psychology and Educational Science

Data-driven Index Formation
According to the MARI Method

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ISBN 978-3-658-39403-5

ISBN 978-3-658-39404-2 (eBook)

<https://doi.org/10.1007/978-3-658-39404-2>

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This book is a translation of the original German edition „Formative Modellierung in Psychologie und Erziehungswissenschaft“ by Fluck, Julia, published by Springer Fachmedien Wiesbaden GmbH in 2021. The translation was done with the help of artificial intelligence (machine translation by the service DeepL.com). A subsequent human revision was done primarily in terms of content, so that the book will read stylistically differently from a conventional translation. Springer Nature works continuously to further the development of tools for the production of books and on the related technologies to support the authors.

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Preface

What you can't describe well, you can't measure. (René Descartes)

Latent constructs, as they occur in test or questionnaire procedures in research and practice in educational science and psychology, “are not simply there and only have to be made observable, but have to be constructed first, building on what can be observed” (Steyer and Eid 2001, p. 4).

In this context, the view of the latent construct, which is in the background and causally causes the response of manifest indicators (e.g., questionnaire items), is only one of two possible perspectives. The item here reflects the underlying construct, which is why we also speak of the reflective measurement model here.

Formative measurement models, on the other hand, describe a different, constructivist view of latent constructs, which, as an alternative to the reflective approach, assumes that some constructs only emerge through the interaction of various and different indicators and are thus causally (i.e., temporally or logically) subordinate to them.

In the behavioral sciences, such formative models are largely unknown, although their application could be profitable here as well (Jarvis et al. 2003). The modeling of formative measurement models will be given space in this book, so that users in education and psychology get to know and apply the alternative to the reflective measurement model. This helps not only in the development of new measurement procedures but also in the modeling of already-known scales, which can be subjected to a critical second look with the knowledge of formative models. This can expand the knowledge of constructs and their measurement.

The first three chapters of this book present and discuss key principles about formative models. Chapter 1 describes the logic of the formative measurement

model in distinction to the reflective variant. Chapter 2 is dedicated to the question of how users can recognize whether formative models can be applied to a certain construct and shows possibilities for the practical implementation of such models. Based on critical aspects of formative models, Chap. 3 discusses their potential for application in educational science and psychology.

Chapter 4 describes a separate approach to the implementation of formative measurement models. The MARI method described here (Fluck 2020b) is used to implement data-driven index formation.

M	Mental experiments are objectified by expert judgments and ultimately determine whether the formative model is appropriate.
A	Analyses of the item designs, based on both qualitative and quantitative data, are used to adjust the scales.
R	Regression analyses additionally support the examination of scale quality by modeling critical validity.
I	Index formation is based on the information obtained in advance and is thus theoretically and empirically sound.

It is particularly important to supplement quantitative data with qualitative data from expert interviews. The integration of such data is central, as the quality of constructs with formative indicators cannot be assessed on the basis of individual key figures alone. In order to be able to calculate and assess formative models, a differentiated view of the construct and the process of test construction is necessary (Albers and Hildebrandt 2006).

This book is intended to provide readers with the necessary basic knowledge of formative models and to enable them to calculate such models using standard methods. In this way, we hope to contribute to a broader knowledge and use of this approach in educational science and psychology.

Aachen, Germany
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October 2020

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Contents

- 1 The Logic of the Formative Measurement Model 1**
 - 1.1 Background: Latent Variables 1
 - 1.2 Formative and Reflective Measurement Models 4
- 2 The Application of the Formative Measurement Model 11**
 - 2.1 Formative or Reflective Modeling? 11
 - 2.1.1 Decision Based on Theory and Factual Logic 12
 - 2.1.2 Decision Based on Empirical Data 14
 - 2.2 Implementation of the Formative Model in Practice 21
 - 2.2.1 Index Formation 21
 - 2.2.2 SEM in the Covariance-Based Approach 28
 - 2.2.3 SEM in a Variant-Based Approach 31
- 3 Formative Measurement Models in Psychology and Education? 39**
 - 3.1 Critical Aspects of Formative Models 39
 - 3.2 Formative Modeling of Psychological Constructs? 42
- 4 Data-Driven Index Formation with the MARI Method 47**
 - 4.1 Mental Experiments 49
 - 4.2 Analysis of the Items 57
 - 4.2.1 Qualitative Analysis 57
 - 4.2.2 Quantitative Analysis 61
 - 4.3 Regression Analytical Validation 68
 - 4.3.1 On the Choice of Regression as a Method of Analysis 69
 - 4.3.2 Selection of Dependent Variables 73
 - 4.4 Data-Driven Index Formation 75
- References 81**

The Logic of the Formative Measurement Model

1

Measuring something that is not directly observable presents us as researchers with a particular challenge. We acknowledge that intelligence, motivation, learning success, satisfaction, etc. are not accessible to direct sensory experience and look for ways to make the impossible (approximately) possible and still capture these constructs empirically.

To build this bridge, we need measurement models that formalize the relationship between latent (i.e., unobservable) constructs and their indicators, which are supposed to capture them approximately. Such indicators can be, for example, individual tasks or questions (items) in a questionnaire.

The literature distinguishes between two types of measurement models, the formative and the reflective measurement model, which are described and differentiated from each other in this chapter. In the research literature, there is a pronounced “dominance of reflective measurement models” (Fuchs 2011, p. 9), which should be familiar to the readers, which is why the special features of the formative measurement model are discussed here in particular.

1.1 Background: Latent Variables

“I only believe in what I see, what I can put on the table in front of me and touch,” says a student. The religion teacher smiles superiorly and asks the student to please put a “pound” of his intelligence on the table.

The teacher, however, has not succeeded in proving God through this rhetorical maneuver. The intelligence of the student may not be observable or tangible at first