Modeling and Measuring Competencies in Higher Education

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The KoKoHs Program

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Over the past decade, tertiary education has increasingly been gaining importance in society. Developments such as the continuously growing number of students in higher education and increasing student mobility have raised questions of efficiency and effectiveness in tertiary education, calling for valid assessments of competencies and student learning outcomes. Assessments of the output of higher education can yield important evidence regarding the effectiveness of this highly important educational sector and thus provide a basis for improvement measures at the individual and institutional levels (Coates and Zlatkin-Troitschanskaia 2019).

Modern higher education focuses on the acquisition of domain-specific knowledge and on the development and promotion of generic (interdisciplinary) skills (e.g. critical thinking), which, according to current surveys amongst employers, are increasingly gaining significance in the 21st century (Association of German Chambers of Industry and Commerce (DIHK) 2015). Such a competence portfolio, acquired over the course of academic studies, is crucial for all professionals and globally engaged citizens and allows for lifelong learning, which is necessary in today's continuously changing age of information.

Despite this sociopolitical consensus and the growing competence orientation (in the context of the Bologna reform), there have been only few evidence-based in-

sights into this field up until the last decade, particularly regarding the competencies of higher education students. Therefore, the German Federal Ministry of Education and Research established the Germany-wide research initiative "Modeling and Measuring Competencies in Higher Education (KoKoHs)"[1] in 2011 and – after a positive external evaluation in 2015 – decided to continue to fund this research in the context of the German program "Modeling and Measuring Competencies in Higher Education (KoKoHs) – Validation and Methodological Innovations" until 2020.

In the first research program, KoKoHs (2011–2015), more than 220 researchers from various fields such as subject-specific didactics, learning psychology, and psychometrics developed first modeling approaches and the corresponding measuring instruments for the valid assessment of student competencies in the context of 24 collaborative research projects at over 70 universities and research institutes, focused on central study domains such as business and economics, engineering, and teacher education (for a detailed description of the first KoKoHs research program (2011–2015) and the individual projects and results, see Zlatkin-Troitschanskaia et al. 2017). These models and tools developed in KoKoHs were one of the key results of this first working phase, which ran until 2015. Another equally important outcome of this research phase were the findings on students' competence levels in different study phases, which revealed many deficits. At the same time, the generalizability of these results was questionable, as some of the newly developed KoKoHs instruments had not yet been comprehensively validated in accordance with a number of validation criteria as recommended in the Standards for Psychological and Educational Testing by AERA et al. (2014). Another shortcoming had been the fact that most of the newly developed test instruments were paper-pencil-based and altogether only few innovative assessments had been developed in the first phase. Based on the results and recommendations from an international audit at the end of the first phase, the second phase of the KoKoHs program was launched nationwide in 2015 with a focus on validation and methodological evaluations.

In this follow-up research program, KoKoHs (2016–2020), more than 100 researchers comprehensively validated KoKoHs assessments and developed new innovative modeling approaches and the corresponding measuring instruments for the valid assessment of student competencies in the context of 16 collaborative research projects at over 40 universities and research institutes, again focused on central study domains such as business and economics as well as teacher education. In this program, one new study domain was included: medicine. Moreover, some of

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1   For further information on KoKoHs, see https://www.blogs.uni-mainz.de/fb03-kokohs-eng/

the projects focused on transferring and adapting modeling approaches and assessments from one domain to another (e.g. from mathematics to economics). Overall, this program consists of three large clusters: four projects focusing on domain-specific competencies in economics and medicine, five projects with a focus on domain-independent competencies such as scientific reasoning and self-regulation skills (for domain-specific and generic competencies, see Zlatkin-Troitschanskaia, Pant, and Greiff 2019), and the largest cluster with seven projects and a focus on teacher education in different domains such as mathematics, physics, or economics (for teachers' competencies, see Cortina, Pant, and Zlatkin-Troitschanskaia 2019).

A common focus of all projects was the in-depth validation of KoKoHs assessments following the validation criteria of AERA et al. (2014). Most projects were also characterized by their focus on the development and validation of complex technology-based assessments, which are mostly performance-oriented (for performance assessment, see Zlatkin-Troitschanskaia and Shavelson 2019). Innovative technology-based test formats such as computer-based learning diaries or mobile apps were also developed and implemented. In this research phase, some of the projects have had a longitudinal design, which has allowed for valid statements about the development of competencies over the course of academic studies. In addition, several instruments developed and validated in KoKoHs have now also been tested and used in many other countries such as Japan, the US, and China, and comparative analyses have already been carried out (for cross-national studies, see Zlatkin-Troitschanskaia et al. 2018).

Overall, in the 40 collaborative KoKoHs projects (which, in turn, comprised about 100 individual projects), theoretical-conceptual competence models and corresponding measurement instruments were developed and successfully validated for selected large study domains (e.g. economics, teacher education, STEM). These models differentiate, reliably describe, and assess the competences of students in different phases of higher education – entry, undergraduate and postgraduate studies. Over 100 newly developed innovative video-, computer-, and simulation-based test instruments were validated across Germany at more than 350 universities with over 75,000 undergraduate and master's students. The assessments focused on both discipline-specific competencies and generic skills, which students and graduates should acquire over the course of their studies and which employers and other stakeholders expect according to the professional and social requirements of the 21st century.

Building on best practices from the first funding phase of the KoKoHs program (2011–2015), the subsequent funding phase ran from 2015 to 2020 and brought together experts from various fields and with different methodological backgrounds in cross-university project alliances within a joint international and interdiscipli-

nary research network. Based on the models and instruments for the reliable and valid assessment of competencies acquired in various study domains in higher education that were developed and empirically tested in the first funding phase, this follow-up research phase of KoKoHs aimed to increase the explanatory power and broaden the scope of use of the KoKoHs test instruments through in-depth validation and to drive methodological innovation in higher education competency assessment.

KoKoHs is the only existing nationwide program in which students' learning outcomes in higher education are systematically, validly, and objectively assessed and analyzed. The KoKoHs program provides unique findings on the acquisition and development of students' competencies in German higher education, which form a significant basis for the optimization of learning and teaching practice.

This book is based on the research and development work conducted in KoKoHs over the past decade and offers a comprehensive overview of current innovative tools and approaches to assessing domain-specific and generic student learning processes and learning outcomes in higher education. It presents the work of all KoKoHs projects, thus offering an insight into the most significant research program focused on student learning outcomes in higher education to date. In this volume, innovative modeling and measuring approaches as well as the newly developed objective, valid, and reliable assessment tools for student learning in higher education are presented and critically discussed, with a particular focus on using the developed models and assessments in both further research and higher education practice.

In addition to presenting key conceptual and methodological findings from work within the KoKoHs program, the 88 authors in this book also present key research results and lessons learned from their research to provide new insights into how student learning in higher education can be assessed in various contexts and to show what we can learn from the assessment results. Most contributions also provide an outlook on possible approaches to implementing the instruments into teaching and learning practice and transfer studies. The authors also give a few examples of how higher education practitioners in particular can effectively support teaching and learning at their universities by using the KoKoHs assessments and tools.

With its very broad spectrum of contributions focused on both innovative research and the practical application of assessments in higher education, this volume offers valuable insights for scientists in higher education research as well as related disciplines such as psychology, educational sciences, lecturers in university practice, university evaluation, accreditation agencies, higher education pol-

icy-makers, students, companies and all other stakeholders interested in higher education student learning outcomes.

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