Professional Competencies
of Future Teachers

Knowledge, Beliefs and Opportunities to Learn
of Middle School Mathematics Teachers in Germany

First Results on the Efficiency of Teacher Education

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Executive Summary

In Germany as well as in many other countries systematic information about how teachers are trained and how they actually perform at the end of their education is almost non-existent. Program descriptions are usually highly idiosyncratic, and the testing of teachers is almost a taboo. MT21 is the first study that tries to shed light on this important field of education.

In an attempt to fill this gap, the knowledge and belief systems of future teachers are investigated as key factors influencing student achievement. If the competencies of the next generations’ students in schools are to be improved, it is necessary to examine their teachers’ resources in terms of knowledge and skills and in particular options for training these teachers in a way that they can effectively support student learning.

In Germany, middle-school teachers are prepared in two different ways. In the first route, future primary and lower-secondary teachers (grade 1 through 10) are trained, in the second future lower- and higher-secondary teachers (grade 5 through 13).

The German MT21 data lead to the following conclusions:¹

- **Teacher education matters!** Future teachers’ knowledge and beliefs depend heavily on how they are trained. They gain knowledge in those fields emphasized in teacher education and their beliefs change in accordance with the curriculum taught at their institutions.

- Regarding mathematical knowledge, future primary/ lower-secondary teachers are at a disadvantage in almost all dimensions measured compared to lower/ higher-secondary teachers. This reflects a significantly lower amount of subject-related learning opportunities.

- There are, however, noteworthy relative strengths and weaknesses associated with the respective routes. Primary/lower-secondary teachers show better results in areas in which they are trained, in particular geometry and data-based activities. As opposed to this observation, lower/higher-secondary teachers perform very well in the sub-domain of functions which is a field strongly emphasized in this version of German teacher education.

In a cognitive perspective primary/lower-secondary teachers perform relatively well in modelling, an area

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¹ In Germany four regions were selected to take part in MT21. In these four regions all teacher-training institutions were sampled. Within these institutions a complete census was taken. The overall sample size was 849.
where lower/higher-secondary teachers display unexpectedly low performance levels. Again, this reflects the moment of emphasis in the corresponding teacher-education programs.

- Mathematical knowledge and knowledge in mathematics pedagogy (also known as “pedagogical content knowledge”, Shulman) are highly correlated in the sense that the ability named first is an important pre-condition for the second. However, mathematical knowledge is by no means sufficient for high achievement!

- Primary/lower-secondary teachers outperform lower/higher-secondary teachers as far as pedagogical knowledge is concerned. Taking into account that both mathematical knowledge and pedagogical knowledge are required to teach well, deficits may exist in both types of teacher preparation.

- Multilevel analyses show that it makes a difference in which federal state a candidate is trained. Future teachers educated in states which provide a longer training do better than teachers elsewhere.

- Student recruitment – or academic selectivity – is another issue that matters. In states where training institutions can select between a high number of applicants, future teachers perform better. This finding has obvious policy implications: Not all states or institutions are able to attract a sufficient number of applicants to fill the available slots in their programs – which would be necessary to meet the foreseeable demand! It appears somewhat contradictory to have strong academic selection standards at the entrance of the respective teacher education programmes and then to hire untrained staff because the training institutions cannot provide enough teachers.

- Indications are that future teachers’ beliefs are changing substantially during teacher education. At the beginning, students show relatively traditional beliefs, apparently seeing little value in teaching methods that provide individual learning opportunities for a heterogeneous group of students. At the end of teacher education, they seem to have a more constructivist-orientated view of instruction, combined with a willingness to support demanding cognitive learning processes. This result challenges existing research claiming that beliefs are relatively stable over time and little susceptible to external influence.
**MT21** demonstrates both the complexity of mathematics teachers’ professional competence and, by implication, the complexity of issues involved in the provision of effective mathematics teacher education programs. In light of this goal, **MT21** provides an important initial data base, allowing and expressing interpretations that will lead to hypotheses to be tested both in research and in practice.

A subsequent internationally comparative study, conducted by IEA under the name “Teacher Education and Development Study: Learning to Teach Mathematics (TEDS-M)” will allow implementing the respective future research. TEDS-M will take place in 19 countries – including Germany and the US. It involves representative samples which allow testing many of the hypotheses outlined in this book and thus contribute to an evidence-based reform of teacher education.

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**About the editors**

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