

# Improving Science and Mathematics Teaching

## The SINUS Professional Development Program

Presentation for the GENERACE Y conference.  
Prague/CZ, Tyršově domě.  
8th November 2012

Dr. Claudia Fischer. Central Coordination Office. *SINUS an Grundschulen*

- ✓ the SINUS professional development program – background, aims and concept
- ✓ Studies in *SINUS an Grundschulen*
- ✓ preliminary results
- ✓ perspectives



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INVESTICE  
DO ROZVOJE  
VZDĚLÁVÁNÍ

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Tato prezentace je spolufinancována Evropským sociálním fondem a státním rozpočtem České republiky.

# Teaching

General aim:

- ✓ improve students' competencies
- ✓ help students reach their full potential
- ✓ ensure an effective process of competence development

Reality in German classrooms:

- ✓ far removed from this target



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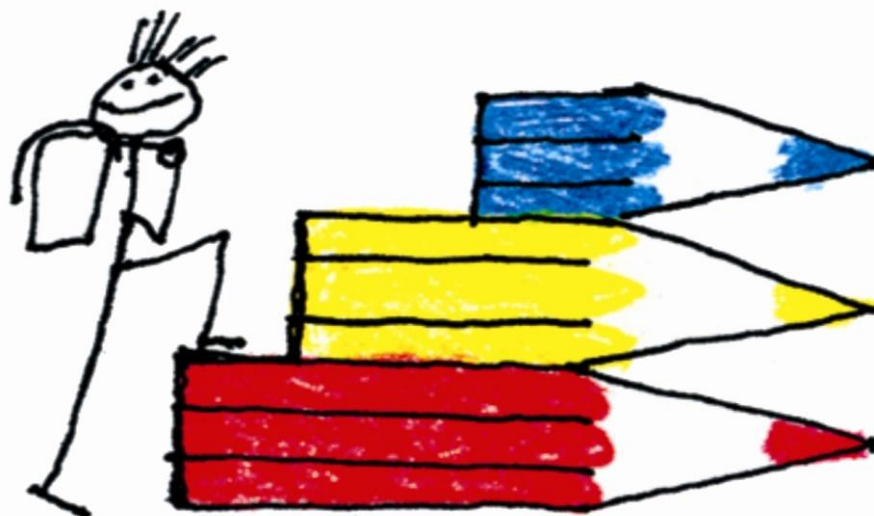
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revealed problems and areas of development:

- ✓ awareness of the key problems of classroom instruction
- ✓ heterogeneity of the students
- ✓ repertoire of teaching methods
- ✓ assessment of students' outcomes

SINUS



## an Grundschulen

Steigerung der Effizienz des  
mathematisch-naturwissenschaftlichen  
Unterrichts

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# Continued Professional Development Programs (CPD) are effective, if...

- ✓ focussed on the *development of teaching*
- ✓ teachers become *active learners* and find tailor-made solutions for existing problems
- ✓ teachers *cooperate* in their schools and beyond
- ✓ programs are structured and coordinated
- ✓ programs are long-term initiatives and
- ✓ implemented on a large scale

(Ball&Cohen 1999; Garet, Porter, Desimone, Birman& Yoon, 2001; Desimone, 2009)

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- ✓ takes in account findings from scientific research
- ✓ target group: teachers in schools
- ✓ focus on science and mathematics
- ✓ initially intended for high schools
- ✓ later: adaption for elementary schools



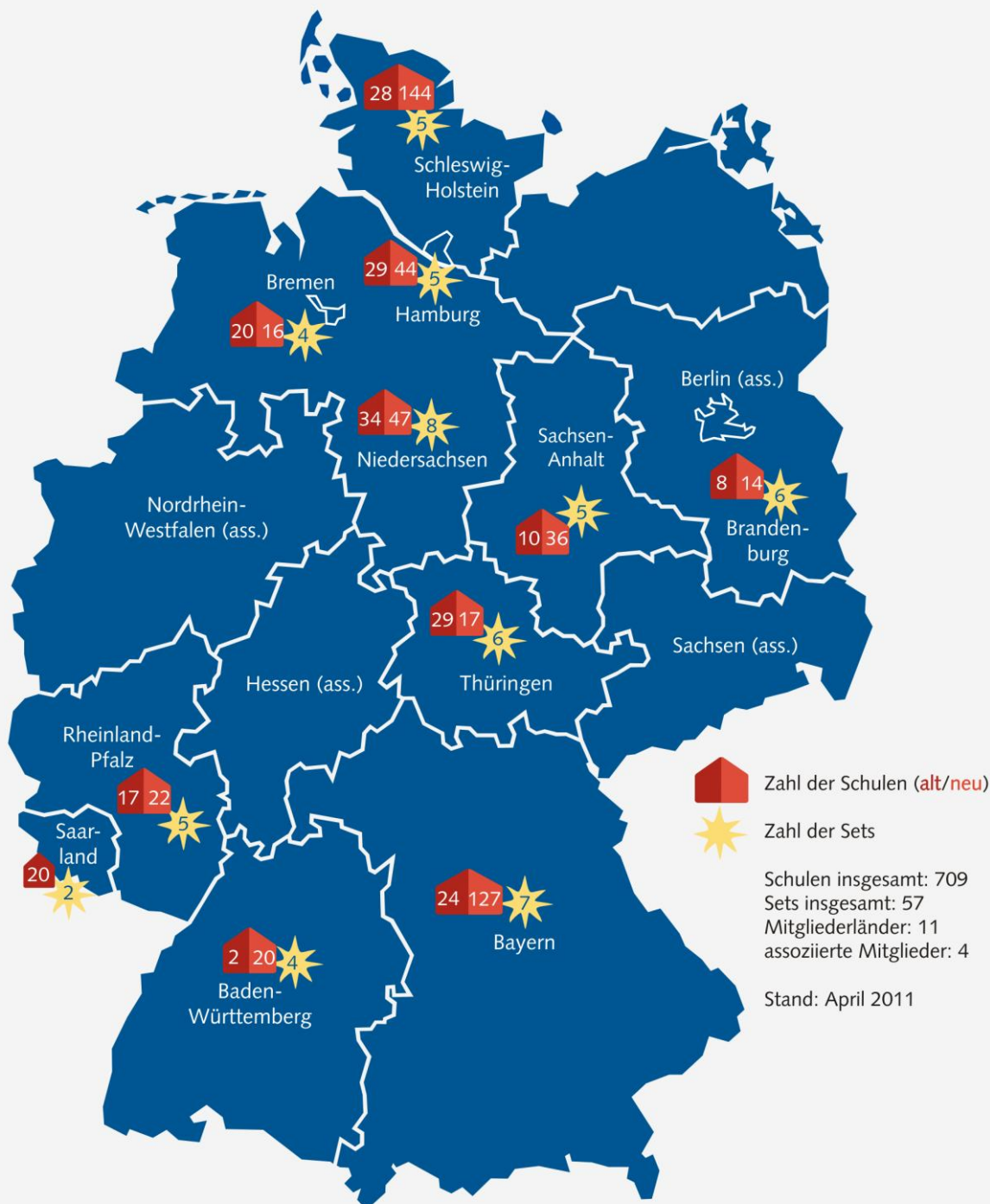
1998-2003  
SINUS  
150 high  
schools  
650 teachers

2003-2007  
SINUS-Transfer  
1,800 high  
schools  
6,000 teachers

2004-2009  
SINUS-Transfer  
Grundschule  
180 (400)  
elementary  
schools  
650 (1,500)  
teachers

2009-2013  
*SINUS an  
Grundschulen*  
650 (860)  
elementary  
schools  
2,500 (4,500)  
teachers



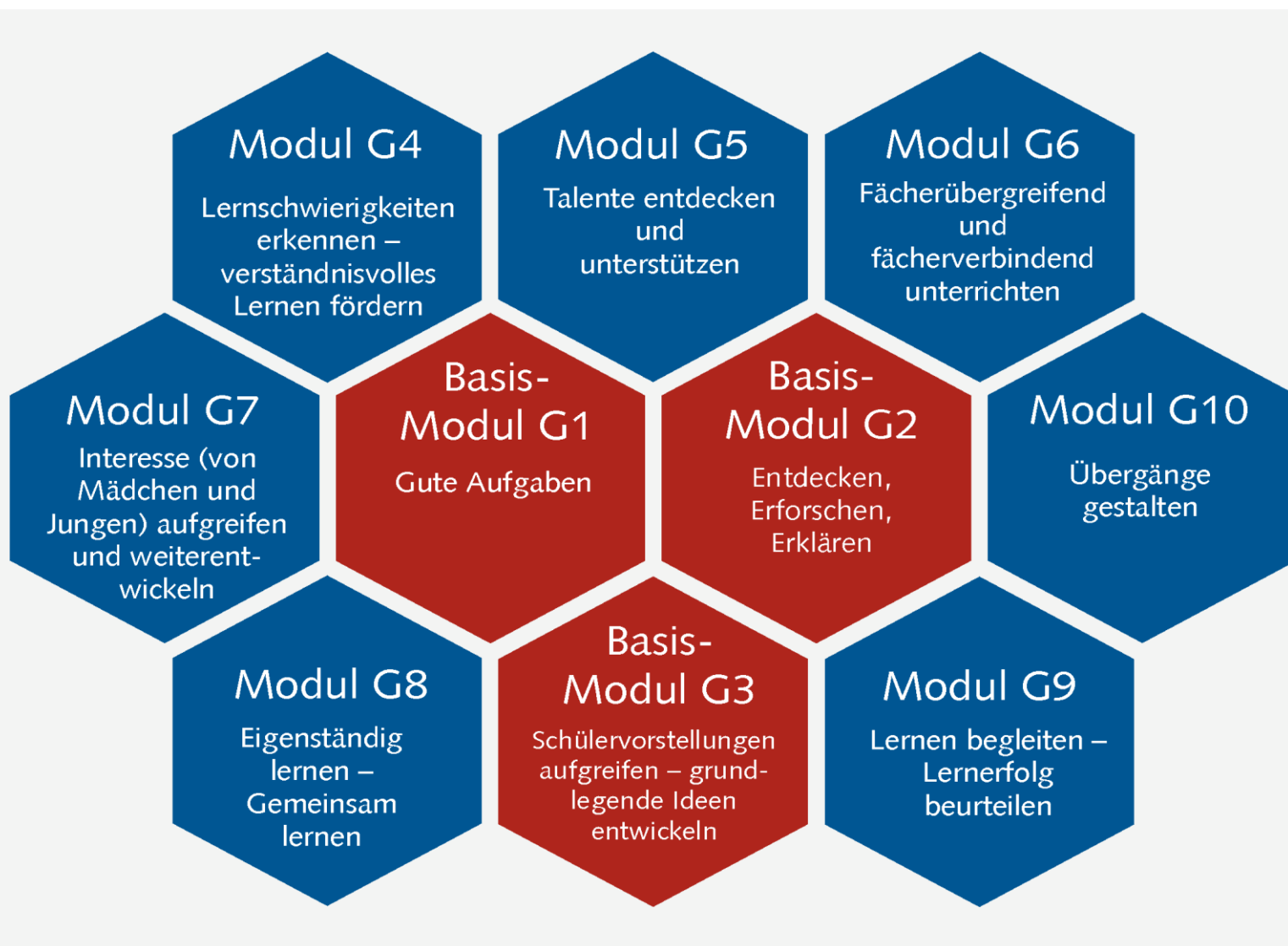


✓ common initiative of the federal states

✓ the federal states cover the expenses with the help of the national ministry of educational affairs

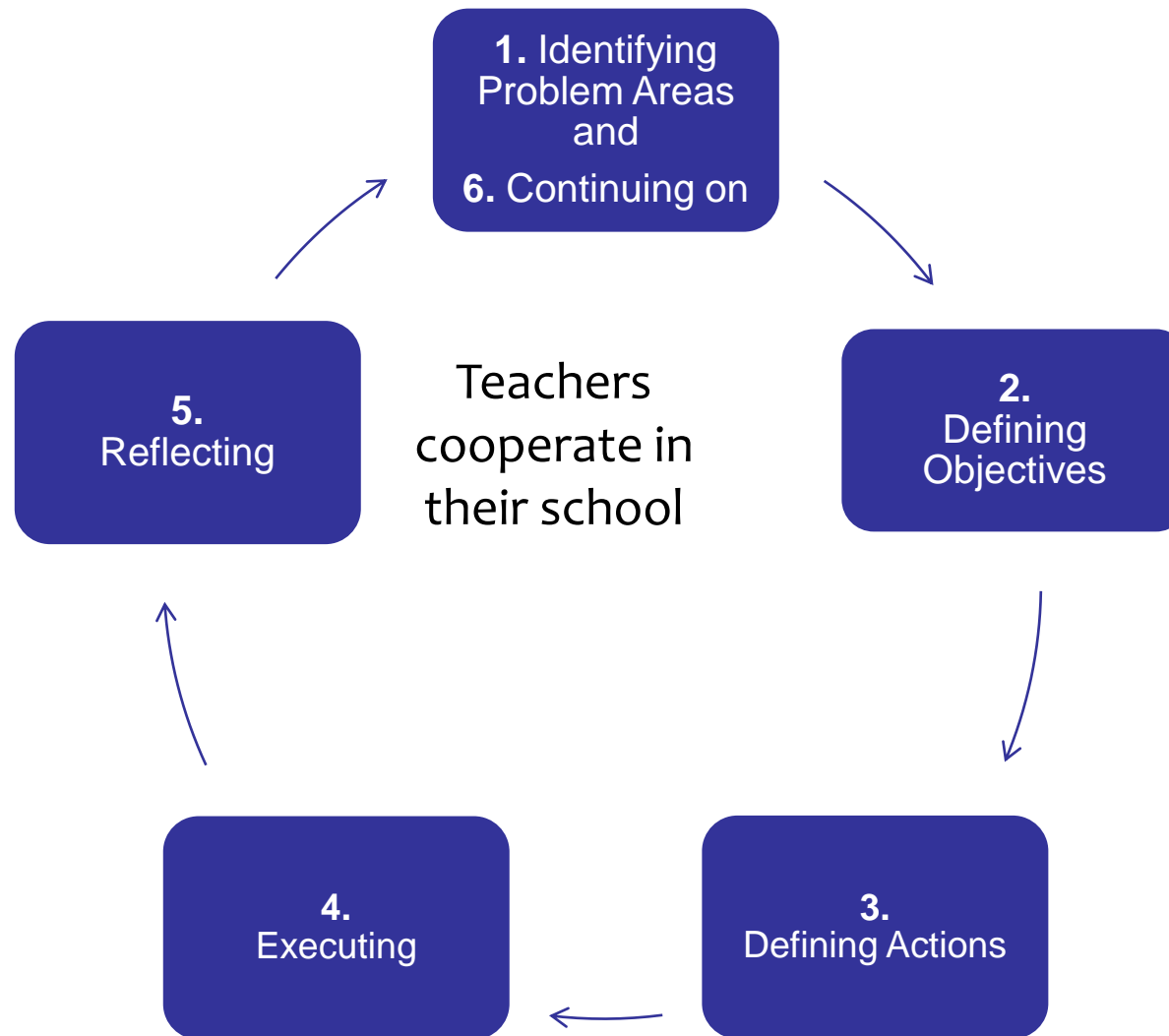
# The SINUS conception of teachers

- ✓ experts in teaching and learning
- ✓ can identify problems in their teaching
- ✓ can work on the problems and improve their skills (new methods, get new information in science and math, give the instruction more meaning)
- ✓ SINUS invites teachers to find suitable solutions for problems and reflect on the results
- ✓ SINUS brings teachers together with scientific and didactic experts
- ✓ administration ensures structure and resources



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# Model of Teacher Cooperation according to the SINUS Concept



## Expectations ...

- ✓ students' motivation, interest and learning outcomes improve
- ✓ measurement of students' learning outcomes
- ✓ teacher cooperation becomes a common practice in the whole school
- ✓ change in teaching effects changes in the whole school

## But:

- ✓ Profound changes in the professional behavior of an experienced teacher take time

- (1) **Reaction:** taking part in the program for several years, understanding its objectives, feeling comfortable with the procedures
- (2) **Learning:** extent, to which participants change attitudes and improve knowledge and skills as a result of taking part in the training
- (3) **Behavior:** change in visible procedures that a training participant includes in his or her routines
- (4) **Results:** final outcomes resulting from the participants attending the program (Kirkpatrick & Kirkpatrick 2012)



## Survey

2010: 332 principals & 1,662 teachers

2013: 850 principals & 4,500 teachers

## Documentations

2010:

48 schools

2012:

45 schools

## Case Studies

2010:

19 schools

2012:

15 schools

**Nationwide Test in Mathematics, TIMSS 2011:**  
80 schools  
(previous participants)

**How do teachers select and analyze tasks in mathematics?**

2012: 80 teachers  
(volunteers)

**Video-Study**  
12 teachers  
(volunteers)

4 annual **reports** from all participating federal states (2010, 2011, 2012, 2013)

**6 Bachelor- & Master-theses**

analyzing (didactical) aspects in Math or Science Teaching



# Methods and Instruments

## Quantitative and qualitative methods

- ✓ **survey:** online-questionnaire (2 different tools for teachers and principals)
- ✓ **documentation:** structured online form
- ✓ **case studies:** various documents
- ✓ **nationwide assessment:** standardized paper-pencil tests
- ✓ **video study:** video recordings, student questionnaires
- ✓ **study about math tasks:** paper-pencil form
- ✓ **reports:** online-questionnaire

## *Reaction:*

- ✓ Program is well accepted
- ✓ Teachers feel supported

## *Learning:*

- ✓ Teachers report gains in several areas
- ✓ Professional cooperation becomes increasingly more common
- ✓ Teachers mostly follow a cyclical professional development process (well defined aims, actions and reflections)



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## *Behavior:*

- ✓ Teachers' documents show more orientation towards students' learning
- ✓ Videotaped lessons give insights in teachers' classroom management and show instructional changes

## *Results:*

- ✓ Students' competencies in SINUS-classes seem to be as high or even higher compared to competencies of students not learning in SINUS-classes



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# Implementing change in the whole school works, if ...

- ✓ the above mentioned aspects can be found in teachers' practice
- ✓ attractive contents, structure, competent advice and feedback become part of teachers' practice
- ✓ teachers with long professional experience have the opportunity to reflect on their routines, try out alternative ways and turn to new solutions
- ✓ not only motivated, engaged and talented teachers are included

# SINUS Experience

can be used for ...

- ✓ the conception of innovative CPD programs on the *content, organizational and resource level* (e.g. teaching other subjects [mother tongue, foreign language] in an innovative way)
- ✓ the implementation and dissemination of innovation *in individual schools and in whole regions*
- ✓ *improving students' competencies* via teaching them by especially trained teachers



- ✓ [www.sinus-an-grundschulen.de](http://www.sinus-an-grundschulen.de)
- ✓ [cfischer@ipn.uni-kiel.de](mailto:cfischer@ipn.uni-kiel.de)



- Ball, D. L. & Cohen, D. K. (1999). Developing Practice, developing practitioners: Toward a practice-based theory of professional education. In G. Dykes & L. Darling-Hammond (Eds.), *Teaching as the learning profession: Handbook of policy and practice* ((pp. 3-32). San Francisco: Jossey Bass.
- Desimone, L. M. (2009). Improving Impact Studies of Teachers' Professional Development: Toward better Conceptualizations and Measures. *Educational Researcher*, 38 (3), 181-199.
- Fischer, C. & Rieck, K. (2010). Improving teaching in science and mathematics. *Better: Evidence-based Education (Science)*, 2 (3), 20-21.
- Garet, M. S., Porter, A. C., Desimone, L. M., Birman, B. F. & Yoon, K. S. (2001). What makes professional development effective? Results from a national sample of teachers. *American Educational Research Journal*, 38 (3), 915-945.
- Kirkpatrick, D. L. & Kirkpatrick, J. D. (2012). Evaluating Training Programs. The Four Levels. Third Edition. San Francisco: Berrett-Koehler.
- Kobarg, M., Fischer, C., Dalehefte, I.M., Trepke, F. & Menk, M. (2012). Lehrerprofessionalisierung wissenschaftlich begleiten – Strategien und Methoden. Münster u.a.O.: Waxmann
- Prenzel, M. & Ostermeier, C. (2006). Improving Mathematics and Science Instruction: A Program for the Professional Development of Teachers. In F. K. Oser, F. Achtenhagen & U. Renold (Eds.), *Competence Oriented Teacher Training. Old Research Demands and New Pathways*. Rotterdam/Taipei: Sense Publishers, 79-96

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