Additional Prospective Collaborative Projects, Group 4

Reinders Duit 14.11.2003
Leibniz Institute for Science Education (IPN), Kiel, Germany

NSF-DFG International Workshop Washington D.C., November 2003
Group IV: Videobased studies on Instructional Practice in Math and Science

In March 2003 I asked the members of group IV to send brief descriptions of their projects and their ideas of cooperation. It seems that finally I have received projects overviews and ideas about cooperation from all members of our group – at least from the members where videobased research on instructional practice is carried out or planned for the near future. I sent most of the responses already to you the past months. But a few are in only recently. In order to make preparation for the meeting a bit easier I send you the whole set of reactions. I also include the reactions from members of group III I also received and a reaction from Peter Labudde who is member of the PISA group. Nevertheless, in his proposal there is also a focus on video based research.

There is certainly quite a substantial overlap of work in groups III (teacher professional development and change of practice). Therefore, I also send this set to the members of this group.

List of Project-overviews
Group IV
(1) Hans Fischer et al., Dortmund, Germany – physics ed.
(2) J. Krajcik, University of Michigan, USA – physics ed. (sketch of cooperation with (1)
(3) Duit, Euler, Lehrke, Prenzel, Seidel, IPN Kiel, Germany, physics ed.
(4) Helga Stadler, Vienna, Austria, physics ed.
(5) Elke Wild, Elke Sumfleth, Bielefeld, Essen, Germany, chem. Ed
(6) Möller et al, Stern et al, Münster, Berlin, Germany, primary ed.
(7) Kathleen Roth, LessonLab, USA, science ed.
(8) Lissy Krussel, Tom Dick, CLT-West, USA, math ed.
(9) E. Klieme et al., Frankfurt, Germany, math. Ed
(10) Elke Wild, Bielefeld, Germany, math ed.
Group III
(11) H. Fischler, H.J. Schröder, Berlin, Germany, physics ed.
(12) R. Demuth, I. Parchmann, C. Graesel, Kiel, Saarbrbücken, Germany, chem. Ed.
PISA Group VI
(13) P. Labudde, Bern, Switzerland, physics ed.

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(1)

Institution: Physics Education, University of Dortmund.

Research staff: Prof. Dr. Hans E. Fischer; Dr. Rüdiger Tiemann; Dr. Georg Trendel; Dipl. Phys. Thomas Reyer; Dennis Draxler, Christina Wirz, Sebastian Labusch (1. teacher exam).

Domain: Physics education

Aims and focus of recent research:

- Development and empirical validation of a theoretical concept and the effect of physics instruction
- Video based analysis of physics instruction in Germany
- Development and empirical validation of physics tasks
- Development and empirical validation of teacher education

Theoretical framework:

- theories of physics learning
- teacher education, quality of teaching
- theories of teaching and learning
- surface and deep structure of physics lessons
- theory-based analysis of teaching and learning

Research methods:

- video-based research, students' surveys;
- student tests for physics knowledge and understanding

teacher questionnaires and tests (about teacher beliefs and professional knowledge)

Results

- The analyses of physics lessons show two types of instruction that can clearly be distinguished by their amount of student-orientation. The classes with a higher amount of student-orientation achieve significantly higher scores in two physics tests. However, there are differences between the classes referring to the deep structure of instruction; there is evidence for variable effects on the students' learning outcome.
- The classes also show no differences in learning progress as measured by TIMSS science scores, and show only average results according to the national sample of TIMSS. So, the sample can be seen as representative for German Gymnasiums. With that in mind, the deep structure can be assumed to explain the poor German TIMSS scores, but not sufficiently explain the performance in our physics tests. On the other hand, the performance in our specific physics tests depends significantly on the surface characteristics and not so much on the content actions of the students.

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- The deep structure of the teachers' education aims contains a very limited number of only two aims: 'learning by experience' and 'constructing theory'. In comparison to Oser's theory of basic models especially the low frequency of the content operation 'generalize/ abstract/ integrate' points out an important deficiency of the students' sequences of content actions: it is a vital step within both of the original operation sequences 'learning by experience' and 'constructing theory'. The low frequency of this important content operations indicates that both sequences of content actions remain incomplete. Probably this is one of the main reasons for the average results of the students' performance.
- The prevailing learning activities can be described as "learning chunks of theory" and "applying chunks of theory". Compared to the idea of scientific literacy as applied in the PISA-study, the observed instruction obviously fosters learning activities that hardly go beyond the second level of scientific proficiency of "argumentation, evaluation and conclusions by scientific data, applying scientific concepts, and making predictions from basic scientific skills" .These have not been supported by the findings based on the observed lessons.

Aims and focus of planned research:

- Development and empirical validation of a theory of physics instruction
- Development of video based of physics teacher training and empirical validation of its' efficiency
- Further explanation of the deficits of German TIMSS and PISA results
- Development of deep structure (high inferent) video analysis

Theoretical framework:

- Theory of basic models of teaching and learning (BMTL, Oser).
- Classroom management using BMTL
- Multi-layer model of instruction.
- Interference of deep and surface structure of students' and teachers' activities during the lessons. Identification of typical patterns.

Research methods:

- Video based classroom study in Germany and Switzerland (2002-2004); n=40 classrooms
- Teacher, students and parents survey;
- Several students tests for physics achievement
- Teachers test for professional knowledge

Cooperation partners (kind of cooperation):

- Prof. Dr. E. Sumfleth, (the extent of the vertical integration of content knowledge of students' on secondary level.
- Prof. Dr. D. Leutner, University of Duisburg-Essen (problem solving processes of

students) - Prof. Dr. M. Prenzel; Dr. T. Seidel, Institute for Science Education (IPN) at the University of Kiel (development of a system of categories for the video analysis) - Prof. Dr. A. Tibergien, University of Lion (development of a system of categories for the video analysis).
Major expectations of cooperation within the NSF-DFG setting: - Development of a shared method for video analysis in physics teaching and learning, development of a multi level theory of physics instruction. - Implementation of the video analysis method in different studies in Germany, France and USA

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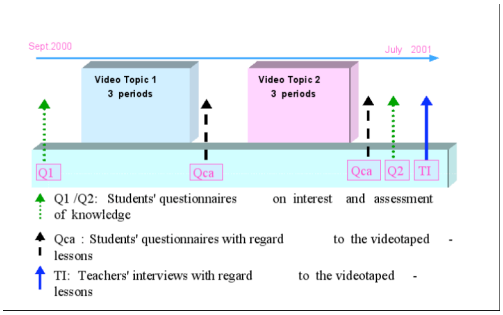
(2)

J. Krajcik, 10/03

Title of Working Group -- Fostering and Analyzing Scientific Practices of Students: Triangulation from Video Analysis and Other Forms of Assessment.

Abstract: Researchers at Essen University - Elke Sumfleth and Hans Fischer along with their grad students and research scientists and researchers from the Center for Curriculum Materials in Science, David Fortus from Michigan State University and Joe Krajcik from the University of Michigan, have been discussing ideas related to scaffolding the inquiry practices of students (writing scientific explanations, planning investigations/experiments, modeling, and analyzing data) to foster scientific reasoning in chemistry and physics. Our main objective is to analyze videotapes of classrooms and students engaged in various scientific practices and triangulate this analysis with other forms of assessment including performance-based assessments, journals, and paper and pencil test. One purpose of our work is to find ways in which teachers can best scaffold students in doing inquiry. Another purpose is to obtain multiple forms of assessing the learning outcomes of students involved in inquiry practices. This work coincides with research interests tied to the Center for Curriculum Materials in Science (CCMS). During the summer, 2 research scientists and 1 graduate student from Essen attend the Knowledge Sharing Institute sponsored by the CCMS and held in Ann Arbor to foster the collaboration.

(3) DFG – NSF International Workshop
Working Group IV - Videobased Studies on Instructional Practice in Math and Science

Institution	Leibniz Institute for Science Education (IPN), Kiel, Germany
Researchers participating	Reinders Duit, Manfred Euler, Manfred Lehrke, Manfred Prenzel, Rolf Rimmele, Tina Seidel, Inger Marie Dalehefte, Lena Meyer, Christoph Thomas Müller, Maike Tesch, Ari Widodo
Domain	Science (Physics) Education
Research already carried out	**IPN Physics Video Study** ***Three phases:*** 2000 to 2002: 13 classes, grades 7/8 (explorative) 2002 to 2004: 51 classes, grade 9 (randomly selected sample) 2004 to 2006: intervention studies (planned) Results of phase 1 are available. Data collection of phase 2 is finalized. Preliminary data available Nov. 2003 ***Aims, Focus*** ◆ To identify major instructional patterns (scripts), with particular emphasis on: (1) goal orientation of instruction, (2) Opportunities provided to scaffold student learning; (3) Taking student conceptions into account and dealing with mistakes; (4) Role and function of experiments. ◆ To identify relationships between patterns (scripts) of instruction and the development of student achievement and affective variables (like interests). ***Theoretical Framework*** ◆ Script concept (Stigler et al.) Two levels of scripts differentiated. Surface level and "deeper" level of learning opportunities provided. No single variables determine the quality of instruction but pattern or "choreographies" of instruction)(Oser & Patry, 1990) ◆ Constructivist view of teaching and learning ◆ Science education related theoretical frameworks (e.g. on the role of experiments) ***Design***  ***Data Analysis*** ♦ **Videos** (Videograph; R. Rimmele, IPN) **Category based coding** (10 s intervals) ◆ Organization of classroom activities (T. Seidel) ◆ Quality of classwork and scaffolding student (T. Seidel) ◆ Role and function of experiments (M. Tesch) ◆ Constructivist oriented science classrooms (A.Widodo)

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	Rating of whole lessons (T. Seidel) **Reconstruction of content structure** (R. Duit, C. Müller) ◆ content structure diagrams of every lesson ⧫ **Teacher Interviews** (C. Müller) ◆ category based coding and qualitative analysis ***Preliminary results (Phase 1)*** ⧫ **Student development within one school year** ◆ Significant differences of ***development of achievement and affective variables (e.g. interests)*** between the 13 classes (344 students). Almost no achievement gain in a number of classes. Decrease of interest in all classes. ⧫ **Instructional patterns** ◆ Time spend on ***classwork*** outnumbers time for student ***individual work***. Percentage of lesson time for classwork ranging from nearly 100% to about 55%; average percentage of individual work about 25%. ◆ During classwork simple forms of ***dyadic interaction*** between teacher and the students predominate. Somewhat narrow variants of a "questioning developing" method prevail. ◆ ***Experiments*** are integral part of instruction. In average 64% of the lesson time the experiment is the key focus, when it is prepared (8%), carried out (28%) and the results are discussed (28%). But only seldom students have a chance to develop the idea of an experiment, to plan it and to analyse results themselves. ◆ Instruction meets ***characteristics of constructivist classrooms*** only to a limited extent. A number of characteristics are not observed at all. ***Fairly often observed***: Exploring prior ideas, providing thinking provoking problems, addressing student conceptions, addressing real life events. ***Missing***: exploring interests, ways of thinking, encouraging students to be self-regulative and reflective, taking into account students critical voices. ⧫ **Instructional patterns and development of achievement and interest** ◆ No effect of classroom organization pattern (such as classwork / individual work) on student achievement gains. ◆ Narrow-focused classwork has a negative effect on the development of student interest in physics. ◆ A positive effect on students' achievement gains: (a) high level of goal orientation (by offering a clear and sound structure); (b) taking in account students' preinstructional conceptions; (c) teaching concepts within everyday life contexts; (d) various means of cognitive activation provided; (e) The knowledge "elements" are deliberately interrelated. ⧫ **Teacher beliefs** ◆ Most teachers' thinking about physics instruction is rather content oriented. Considerations about the content in question predominate planning, reflections about students' perspectives play a rather minor role. ◆ Teachers' subjective theories about teaching and learning physics meet characteristics of the constructivist view only marginally. Most teacher do not hold explicite views of students' learning. They are not or only marginally informed about recent views in science education and psychology. ◆ It appears that student achievement gains are best for teachers who hold that learning has to be continuously supported (in the sense of cognitive apprenticeship).
Sketch of planned research	As mentioned above data from the second phase of the study will be processed in 2003/2004. Preliminary hypotheses gained in the first (explorative phase) will be further investigated. The focus of the third phase will be two studies on teacher professional development.
Co-operation already running	◆ Prof. Dr. K. Reusser (University of Zurich) & Prof. Dr. E. Klieme (DIPF – Frankfurt) – "parallel" video study on math instruction (these groups also participate in the DFG – NSF Workshops) // close cooperation with regard to methods (e.g. parallel teacher questionnaires) and data interpretation ◆ Prof. Dr. Peter Labudde (University of Bern): There will be a study in the German speaking part of Switzerland in 2003/2004 that basically employs the same research design as the second phase of the IPN video study (also this group participates in the DFG – NSF Workshops) – close cooperation ◆ Co-operation with the German BiQua Projects – regular meetings and

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	information exchange
Major expectations of co-operations within the NSF-DFG setting	The focus of group IV is practice studies, i.e. research on conditions and outcomes of actual math and science instruction. The number of such studies so far is limited. Research of this kind has proven essential for attempts to improve instructional practice (e.g. in quality development attempts). Recent advances of video-analysis techniques allows much deeper insight into teaching and learning processes than was possible so far. Close international co-operation is necessary concerning research methods, data interpretation and exchange of results.
Comments on the focus of the above outline of the IPN video-study	The IPN video-study is member of two working groups, namely working group 3 on "Professional Development / Changing Practice" and group 4 "Videobased studies on instructional practice in math and science". The outline provided here is focused at the contribution of the video study in working group IV. Activities in group 3 are organized by Tina Seidel, activities in group 4 by Reinders Duit

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(4) DFG-NSF International Workshop, March 2003
Working Group IV
Videobased Studies on Instructional Practice in Math and Science

Institution: University of Vienna
Names of researchers participating: Helga Stadler
Domain: Math or Science Education: Science Education (Physics)

Sketch of research already carried out
- aims, focus:
1) Videobased studies of teaching and learning processes in physics class with a focus and gender issues
2) Evaluation of projects, where we try to support the professional development of science teachers. Within that projects videos are used as a tool to foster the professional development of teachers.
- theoretical framework:
Educating the reflective practitioner (Schön 1987): Krainer (1998), Altrichter, Posch (1998): Teachers have to be supported by structures provinding opportunietes to reflect their teaching and build networks.
Stadler (2004): Videos as a tool to foster networking and reflection
- research methods: analyses of videos (discourse analyses), stimulated recall, interviews, questionnaires
- (preliminary) results: s. papers

Sketch of planned research

- aims, focus:

1) developing and documenting, evaluating ways how video based action research and video based external, professional researchers might influence each other and can be used by both sides.
2) Videobased research on gender issues in physics (science) class and how to use these results (combined with teachers findings) in teacher education or quality development projects.
3) Developing ways how to use videos of different nations in teacher education

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4) Using class videos of different countries to compare teaching and learning styles in terms of gender sensitive class.

Cooperation already running:
- co-operation partners:
- kind of cooperation

Major expectations of co-operations within the NSF-DFG setting: cooperations between a small number of partners, who already have experience on the topics mentioned above.

Further comments

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(5) DFG-NSF International Workshop, March 2003

Working Group IV

Videobased Studies on Instructional Practice in Math and Science

Institution	University of Bielefeld
Names of researchers participating	Prof. Dr. Elke Wild
Institution	University of Essen
Names of researchers participating	Prof. Dr. Elke Sumfleth
Domain:	Chemestry; Science Education
Research already carried out	
- aims, focus	Evaluation of a lesson sequence (including homework) to be implemented at the beginning of chemistry instruction (7th grade), which was designed to foster student's understanding and motivation by taking into account students daily live conceptions
- theoretical framework	Research on students' daily live conceptions, conceptual change Research on co-operative learning, Theories of motivation (self-determination theory, theories concerning goal orientations and interests)
- research methods	Quasi-experimental design; evaluation by using quantitative techniques; collection of data by using questionnaires, standardized achievement tests and videotaped lessons / small group interactions
- (preliminary) results	• Taking into account students' daily live conceptions (subjective theories) was conductive in terms of cognitive and motivational gains; in contrast to our hypotheses, however, both types of instruction (i.e., traditional teacher-oriented class discussion vs. co-operative group) seem to be equally effective. The ongoing analyses focus on a deeper understanding of the group interaction. • Students' motivation and understanding did not differ as a function of alternative types of homework (collaborative work on transfer tasks vs. "normal" homework sessions without specific instruction). Further analyses of videotaped interactions will help us to differentiate the quality of dyadic interactions (in terms of guided participation, direct instruction etc.) • correlational analyses support the assumption that students' are more likely to be mastery oriented and intrinsically motivated the more they perceive their teachers and parents as autonomy supportive. At the same time, avoidance and aversion increases the more students's perceive their teachers and parents as controlling, performance oriented and criticizing
Cooperation already running:	Helmuth Fischer (University of Dortmund) Jens Möller (Teutolab, University of Bielefeld)

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- cooperation partners	Researchers from the field of learning motivation (z.B. Krapp, Ryan), self-regulation (B. Schmitz) and emotion (Pekrun); colleagues involved in PISA and other international comparative studies (z.B. Bos; Gogolin); math education (IDM, Bielefeld)
- kind of cooperation	using the same questionnaires, cooperation in the development of intervention programms (addressing parents and teachers)
Major expectations of cooperations within the NSF-DFG setting	Exchange about coding systems to be suitable to identify powerful learning environments in terms of fostering (cognitive) activation of students, their understanding and learning motivation, prevention of inert knowledge
Further comments	I would appreciate to cooperate with other researcher who are interested to integrate ideas from educational psychology and science education

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(6) *BIQUA-Project Münster-Berlin*

Prof´in Dr. Kornelia Möller, Berenike Gais, Angela Jonen, Thilo Kleickmann (University of Münster)

Prof´in Dr. Elsbeth Stern, Ilonca Hardy (Max-Planck-Institut Berlin)

If you are planning research in the field of video-studies please specify these studies, also specify theoretical frameworks.

Note:

The following title and description refers only to that part of our BIQUA-Project which is of interest for the workgroup "Videobased studies on instructional practice in math & science"

Title:

Implementation of primary science teaching by means of in-service teacher training ("Implementierung von naturwissenschaftlichem Sachunterricht durch Lehrerfortbildungen")

Keywords:

Primary science teaching, teacher performance in constructivist learning environments, video-study

Description

Within the field of science teaching the constructivist paradigm has proven to be a fruitful basis for designing learning environments. Despite the ongoing debate about the term of constructivism itself and its implications for teaching, a moderate constructivist view on science learning and teaching seems to be consensual throughout the world (Duit 1996, Labudde 2000, Staver 1998). In contrast, recent studies have shown considerable discrepancies between what research results tell us and their application in everyday teaching practice (Prenzel 2001).

The research project presented here is situated in the domain of primary science teaching. Its goal is to investigate the efficiancy of different modules of in-service teacher training. These modules aim at enriching teachers´ paedagogical content knowledge (sensu Shulman, 1986). The project focuses on how these modules change teachers´ orientation in constructivist principles for designing instruction. For this purpose we assess the teachers´ pedagogical content knowledge as well as their observable teaching behavior. In all, 54 primary science teachers participate in this study.

The following questions lead the investigation:

- How do the different training modules affect teachers´ pedagogical content knowledge and classroom actions?
- How are teachers´ pedagogical content knowledge and their classroom actions related?
- How lasting are the effects of the different training modules?

For this purpose three different experimentally controlled teacher training modules will be carried out. Their effects on the teachers´ pedagogical content knowledge will be assessed by use

of a questionnaire, which concentrates on constructivist orientations in science learning and teaching.

To mark the effects on teacher performance, three lessons of a subgroup of 30 teachers will be videotaped (3 x 90 minutes per teacher) and the video data categorized. For analysis and classification we will use an instrument which is derived mainly from existing instruments like the STAM (Secondary Teacher Analysis Matrix, Science Version) by Gallagher and Parker (Simmons *et al.* 1999), the CLES (Taylor/ Fraser/ Fisher 1997) and the COSC (Constructivist Oriented Science Classroom) by Widodo/ Duit (2001). Those instruments were designed for use in secondary physics classrooms, the latter for students in Germany. As the new instrument is to be used in primary science lessons (focus on physics), an adaption has to be made to the specific circumstances in German primary schools. Another adaption that has to be made concerns the patterns of instruction classified by the instrument. While the instruments mentioned above discriminate between didactic teaching styles on the one hand and constructivist teaching styles on the other hand, the intention of the new instrument is to be susceptible for multiple possible patterns of instruction.

The questionnaire and the video analysis are the two main instruments that will be used in the investigation. Development and validation of the questionnaire have been completed, data has been collected and is beeing analyzed. The development of the video analysis instrument is in progress; at the moment the theory-based categories are being refined and validated in field tests. Collection of video data will start in september 2003.

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Auswertungsverfahren des DFG-Projekts "Lehr-Lern- Prozesse im Physikunterricht - eine Videostudie". Kiel: IPN, S. 91-94.

(1) If you already co-operate with other groups, either with members of the present groups or with other people, please specify.

In contact with Duit, Labudde, Adamina

(2) What are your major expectations concerning co-operation? Please specify the research (or development) issues where you are interested in co-operation?

Exchange on

- Development of a high-inferent video analysis instrument, especially for constructivist orientation in primary science classrooms
- surface structures and functional structures of science lessons and teaching in primary school

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(7)

Institution	LessonLab, Inc., Santa Monica, California
Researcher	Kathleen Roth
Domain	Science education

TIMSS 1999 Science Video Study
Research Project to be Completed March, 2004

Aims/Focus
Describe 8th grade science teaching and student opportunity to learn in five countries: *How is science represented in the lessons?*
Compare science teaching in high-achieving and lower-achieving countries.
Develop coding strategy for assessing multiple dimensions of science teaching that can be adapted for use in teacher professional development
Prepare 5 lesson videos from each country for public release (especially for use in teacher professional development)

Theoretical Framework
Science teaching as a cultural activity
Science teaching integrates knowledge from the science community, the education community, the classroom community, and the culture in which the teaching occurs.

Research Methods:
--Stratified random sample of 100 8th grade science lessons in each of 5 countries: Australia, Czech Republic, Japan, The Netherlands, the United States.
--All lessons coded by international team (including native speakers from each country) with 85% inter-rater agreement on all codes.
--Each lesson was reviewed 12 times to code different dimensions of science teaching, beginning with organizational structures and students' responsibilities and then examining various ways science is represented in the lesson:
- •science as content topics,
- •science as different types of ideas,
- •science as organizing and connecting ideas,
- •science as the practice of supporting ideas,
- •science as doing inquiry and practical work,
- •science as collaboration,
- •science as communicating,
- •science as relevant to students' lives

--Text analysis computer program was used to analyze teacher vs. student words and frequency of science words

Results
The report is in final stages of drafting and will then be reviewed by U.S. National Center for Education Statistics before public release in Spring 2004.

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Science Teacher Learning from Lesson Analysis
New project started October, 2003

Aims/Focus
To study the impact of two different versions of professional development programs for elementary science teachers, both of which include lesson video analysis as a core activity: Group One uses a structured framework (based on TIMSS video study coding strategies) to guide lesson analysis; Group Two uses a teacher inquiry approach to analyzing science lessons.

Research Questions: What are the comparative impacts of two different practice-based professional development programs that vary in the kinds of support and guidance they provide teachers? How do teachers changes in terms of a) knowledge of selected science content, b) abilities to analyze science teaching, c) development of a shared language for talking about science, and d) science teaching practices? How does teacher participation in these programs impact their students' learning?

Theoretical Frameworks
Teacher learning from analysis of practice; lesson study
Pedagogical content knowledge
Cognitive apprenticeship and scaffolding
Knowledge base for science teachers

Professional Development Activities:
-Two groups of teachers, 25 teachers in each group
-Both groups attend 3-week Summer Institute, participate in monthly teacher inquiry groups across school year, and do lesson analysis online -
-Both groups have experienced leaders
-Group A approaches lesson analysis from a "lesson study" approach, where teachers define the framework for looking at the lessons
-Group B are guided in their lesson analysis by a structured framework based on TIMSS video study codes – to support their "seeing" the science in the lessons.
-Both groups receive science content instruction on specific topics during Summer Institutes
-Both groups practice analyzing lessons using TIMSS videos (look at someone else's teaching) – focusing on the content topic focus
-Both groups develop lesson plans for teaching the content topics they are studying
-During school year, small inquiry groups analyze videos of their own teaching of the selected topics in addition to TIMSS videos

Research Methods
-Teachers are videotaped teaching the selected science content before program participation (2 lessons) and their students' learning is assessed
-Teachers analyze a videotaped lesson pre- and post-program to assess growth in ability to analyze science teaching
- Teachers' knowledge of the selected content is tested before and after the Summer Institute; selected teachers are interviewed
- Teachers are videotaped teaching the same content at the end of the program (2 lessons) and their students' learning for the unit of study is again assessed
-Entire cycle is repeated with a second group of teachers

Results
This project just started.

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No current cooperations underway
Expectations of Cooperation within the NSF-DFG Setting: • Development of a product that shares different strategies for video analysis of science teaching with the goal of developing a shared language (among researchers, teachers) for talking about science teaching • Possibly a plan for analyzing TIMSS videos and German videos of science teaching using a shared protocol

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(8) DFG – NSF International Workshop
Working Group IV - Videobased Studies on Instructional Practice in Math and Science

Institution	Center for Learning and Teaching in the West (CLT-West)
Researchers participating	Libby Krussel, Tom Dick, GT Springer, Barbara Edwards
Domain	Mathematics Education
Research framework	**Teachers' Discourse Moves** *Discursive Moves* - classroom patterns of language usage in both exposition and dialogue (see Cooney, Davis, & Henderson) *Discursive Nature* - univocal versus dialogic (see Knuth & Peressini) univocal discourse is "one voice" (the teacher's), and is characterized by the teacher evaluating student responses as sole authority dialogic discourse has multiple voices (both students and teacher), and is characterized by teacher eliciting and listening carefully to student responses with purpose of generating meaning from them *Discursive Foci* - three aspects of discourse (see Sfard) around mathematical objects ◆ pronounced focus: the actual words used by the speaker ◆ attended focus: what the speaker appears to be referring to (looking at, listening to) ◆ intended focus: the speaker's interpretation of the pronounced and attended foci *Discursive Consequences* - can be immediate (influencing the present discourse) can be long-term (influencing classroom norms for discourse) can be both cognitive and affective NOTE: A teacher's discourse move can have unintended consequences, such as the lowering of the cognitive level of a mathematical task (see Stein, Smith, Henningsen, Silver)
Sketch of planned research	The framework is being applied to a study of videos of a discourse-rich advanced geometry class for inservice and preservice teachers. The goal is to gain a better understanding of the consequences of various teacher moves.
Co-operation already running	There is interest in the framework within CLT-West as it might apply to online asynchronous discourse in a distance education setting as well as how it might apply to collaborative problem solving workshops (such as Uri Treisman's Emerging Scholars program).
Other possible co-operations	There is potential for the framework to be used not only as a research tool but also as a framework for discussion by teachers in professional development. As such, working group III on "Professional Development / Changing Practice" may have

within the NSF-DFG setting	some interest in the framework.

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(9)

Institution: German Institute for International Educational Research, Frankfurt/M.

research staff:
Prof. Dr. E. Klieme; Dr. H.G. Hesse; Dipl. Päd. F. Lipowsky; Dipl. Psych. K. Raokczy;

Domain: Math

Sketch of research already carried out

aims, focus:

- Development and empirical validation of a theoretical concept of instructional quality
- videobased comparison of mathematical instruction in Germany and Switzerland
- relation between teacher beliefs and instructional practice

theoretical framework:

- theories of mathematical learning
- teacher effectiveness
- theories of teacher beliefs and teaching competence
- constructivist approaches
- theory-based analysis of dimensions of instructional quality
- intercultural comparison of didactical approaches and classroom-management
- multi-faceted explanation of instructional effectiveness

research methods:

- video-based research, students' surveys;
- student tests for mathematical knowledge and understanding
- teacher questionnaire (representative survey about teacher beliefs and teacher-reported instructional practice in Germany and Switzerland)

results

- It was possible, to generate and validate three dimensions of instructional quality with special functions: the classroom-management and the student orientation correspond with classical concepts of instructional quality. Furthermore performance gains on the class level are predicted by the level of "cognitive activation", whereas interest gains are predicted by the degree of student orientation. (This research was done in the context of the TIMSS video study while Eckhard Klieme was a member of the TIMSS video research group at the Max Planck Institute, Berlin)
- The comparative instructional surveys TIMSS and PISA have shown, that German students perform less well in mathematics overall, and that they are especially weak in more complex comprehensive tasks requiring problem solving competence. This is the starting point for discussion. The results motivated a small comparative study, analysing and comparing 30 German and 30 Swiss mathematical lessons that were recorded for the TIMSS videostudies in 1995 and 1999. The results have shown, that the Swiss sample

displays higher levels of classroom management and student orientation, but no Swiss superiority in "cognitive activation" was yielded.

- Certain kinds of teacher beliefs (constructivist beliefs about student learning, epistemological understanding of math as an ongoing creative process, attribution of success or failure to teacher behaviour) were shown to be related to more demanding instructional practices

Additional Prospective Collaborative Projects, Group 4

Sketch of planned research:

aims, focus:

- Development of a broader, yet math-specific theoretical concept of instructional quality
- Analysis of the efficiency of various didactical approaches, particularly instruction with high-level discourse
- Contribution to an differentiated explanation of the Swiss superiority in mathematics, as shown by TIMSS and PISA
- Development of a more didactical system of categories for videoanalysis
- Development and implementation of video-based teacher-training (long-term goal for transfer activities)

theoretical framework:

A. Longitudinal analysis of instructional effects

A1. The three factors of instructional quality (classroom management, student orientation, and cognitive activation) should be replicated, become more subtly differentiated and made more concrete from a didactical perspective.

A2. The study will contribute to a differential theory of instructional effects on achievement and motivation.

A3. Special attention is given to constructivist elements of instruction, involving high-level discourse, proof, group problem solving, scaffolding (esp. on word problems) and other kinds of "cognitive activation".

B. Microgenetic analysis of the development of mathematical understanding.

B1. How do previous knowledge, student under- standing and motivation influence students' learning activities and results?

B2. Which components of cognitive outcome in Geometry learning (knowledge and understanding) can be discriminated, and which depth of understanding can be expected from three periods of instruction on the Pythagorean theorem?

B3. Which characteristics of instruction moderate the relation between previous knowledge and student achievement (Klieme, 2001)?

C. Inter-cultural comparison

C1. Identification of typical teaching- learning processes (patterns).

C2. Research into professional teacher knowledge and its relation to self- reported or observed teaching practice (Shulman 1986, Bromme 1992, Schoenfeld).

research methods:

- videobased classroom study in Germany and Switzlerand (2002-2004); n=40 classrooms
- teacher, students and parents survey;
- several students tests for mathematical achievement

Cooperation already running:

Additional Prospective Collaborative Projects, Group 4

cooperation partners (kind of cooperation):

- Prof. Dr. K. Reusser, Dr. C. Pauli, University of Zurich, Switzlerand (implementation of the study)
- Prof. Dr. K. Reiss, Dr. A. Heinze, University of Augsburg, Germany (cooperation issue: „Argumentation and proof activities in mathematical instruction")
- Prof. Dr. M. Prenzel; Dr. T. Seidel, Institute for Science Education (IPN) at the University of Kiel (development of a system of categories for the videoanalysis)

Major expectations of cooperation within the NSF-DFG setting:

- Development of a didactical system of categories for videoanalysis in mathematical instruction
- Implementation of the sytem of categories in a small-scale study in Germany, Switzerland and USA

Additional Prospective Collaborative Projects, Group 4

(10) DFG-NSF International Workshop, March 2003

Working Group IV

Videobased Studies on Instructional Practice in Math and Science

Institution	University of Bielefeld
Names of researchers participating	Prof. Dr. Elke Wild
Domain:	Math
Research already carried out	
- aims, focus	Identification of proximal processes underlying the development of literacy and motivation in the domain of mathematics
- theoretical framework	Self-determination theory (Deci & Ryan, 2002) Stage-environment-fit-approach (Eccles et al., 1993) Approaches concerning goal orientations (Pintrich, 2000), interest (Krapp, 1998) and achievement motivation (Dweck, 1993)
- research methods	➢ **Longitudinal Study** Since 2001 a sample of appr. 250 third graders had been (and still will be) visited every spring time at home. Data was collected via math tests (from IGLU/PIRLS), interviews and questionnaires addressed to students, parents and teachers. In addition, a subsample (appr. 40 student-mother-dyads) were videotaped during homework session. The subsample was recruited on base of the achievement test-scores (app. 30% low achieving students, 30% average students, 30% high achievers) o Okt./Nov. 2001: n = 40 dyads with fourth-graders (age: 9-10), 3 videotaped standardized interactions, two dealing with more and less structured tasks in mathematics, the third focusing a "plan-something-together"-task. o Okt./Nov. 2002: n = 35 dyads with fifth-graders (age: 10-11), 2 videotaped standardized interactions, one concerning the solution of a mathematical problem ➢ **Analysis of videobased data** Using videotaped interactions from a pilot study two coding-systems were developed and validated to analyse parents´ instructional strategies during homework situations: categories refer to parental autonomy support as well as to instructional stategies of parents that are supposed to foster (impair) self-regulation and mathematical understanding

Additional Prospective Collaborative Projects, Group 4

- (preliminary) results	The more autonomy support of parents (in terms of: use of distancing strategies, requiring the child to handle the task in a self-regulated way, guidance only in case the child ask for help), competence support (in terms of: scaffolding when dealing with failure or complex tasks that may overburden the child's actual completence; fostering a positive but realistic self-concept by informative feed-back; withdrawing from directive, controlling or low-level instructions) the more the child will take over responsibility, show self-regulation and compliance, feels competence and self-determined. Accordingly students described themselves as more intrinsically motivated and identified with the tasks.
Cooperation already running: **- cooperation partners**	Researchers from the field of learning motivation (z.B. Krapp, Ryan), self-regulation (B. Schmitz) and emotion (Pekrun); colleagues involved in PISA and other international comparative studies (z.B. Bos; Gogolin); math education (IDM, Bielefeld)
- kind of cooperation	Using the same questionnaires, cooperation in the development of intervention programms (addressing parents and teachers)
Major expectations of cooperations within the NSF-DFG setting	Information on and discussion of experiences on videobased research methods to integrate approaches from educational psychology (addressing motivational and cognitive issues) and math education
Further comments	I would appreciate to cooperate with other researcher who refer to / are willing to analyse differences and similarities in interactions students experience in learning situations in school and at home in order to identify the specific potential and risks of both learning situations (in terms of fostering a deeper understanding mathematical problems, self-regulation competencies, learning motivation)

Additional Prospective Collaborative Projects, Group 4

(11) DFG-NSF International Workshop, Working Group III:
Professional Development / Changing Practise

Names of persons participating	Prof. Dr. Helmut Fischler, Hans-Joachim Schröder
Institution	Free University Berlin
Domain	Physics education
A model of professional development (pd) / changing practice	
Goals of pd approach	The goal is to improve the quality of science (physics) teaching through enhancing teachers' subject related pedagogical and psychological expertise.
Important features of our pd approach	Reports on traditional training courses for teachers in all phases of teacher education, aiming at long-lasting modifications of teachers' competencies, show only little effects even when these courses are prepared carefully. In our view, the main reason for this situation is the lack of congruence between teachers' already existing ideas and conceptions about teaching and learning on the one hand and topics and processes dealt with in teacher training courses on the other. Therefore, our pd approach addresses individual teachers and integrates ideas offered by research and practice fields in which enduring changes of behaviours depending on mental processes play a significant role. The central idea of our approach is to modify teachers' conceptions about teaching and learning by taking their existing conceptions as a starting point for the process of change. We call our approach: **Subject related pedagogical coaching**
Theoretical framework of our pd approach	- Theories of cognitive and emotive therapy - Psychological theories emphasising individuals' subjective theories as the basis for their reflective decision making - Constructivist view: Teacher education should have the same characteristics as teaching processes: Already existing ideas and conceptions of learners are an important prerequisite for further learning processes.
Results and observations	We have begun a research project which we expect to deliver us empirical results (see below).
Research project: Modifying teachers' conceptions about teaching and learning and their decision making in classrooms	
Researchers	Helmut Fischler, Hans-Joachim Schröder (Berlin), Sabine Kirchner, Peter Zedler (University of Erfurt)
Sketch of research	

Additional Prospective Collaborative Projects, Group 4

still running	
Aims	To help teachers solve their teaching problems by modifying and extending their repertoire of behavioural patterns and their way of perceiving classroom situations.
Theoretical framework	See above
Research methods	- Initial analysis: Identification of teachers' conception by means of interviews. Communicative validation of teachers' reconstructed conceptions. Videotaping and analysing of two lessons. Comparing teachers' conceptions with their actions. Measuring students' achievements and identification of their specific attitudes towards science education. - Treatments to change teachers' expertise: Modification of their views towards and their rules about appropriate decision making in processes of teaching and learning by means of coaching procedures. - Final analysis: similar to methods of the initial analysis.
Questions under investigation	What are the differential effects of different coaching processes? Interrelations between teachers' conceptions about teaching and learning and their decision making in classroom situations. Which school context is helpful for a teacher to begin and to maintain an innovative practice?

Additional Prospective Collaborative Projects, Group 4

(12) DFG-NSF International Workshop, Working Group III:
Professional Development / Changing Practise

Institution	Leibniz-Institute for Science Education (IPN), Kiel Saarland University, Saarbrücken
Researchers and educators	Prof. Dr. Reinhard Demuth, Prof. Dr. Ilka Parchmann, Anja Baer (IPN), Uwe Amthor (teacher and IPN) Prof. Dr. Cornelia Graesel, Thomas Puhl (Saarbrücken)
Domain	Education in chemistry
Project start / operating time	2002 – 2004 (DFG) new proposal in preparation (2004-2006)
Goals of pd approach	*Outcomes for practise*: Change of co-operation cultures in schools; enhancement of teachers competencies and attitudes / beliefs about "chemistry and good chemistry teaching and learning" (main foci: importance of contexts and basic concepts; role and interaction between teachers and students; interaction of planning, diagnosis and optimisation) *Theoretical Outcomes*: Development, evaluation and validation of a model for co-operation in school departments on the one hand and between school practise and research on teaching and learning on the other hand
Important features of our pd approach	Teachers´ training courses with at least two workshops and practical trials in between (process-orientation) Combination of jointly planning and reflection and individual specification within a given framework (the concept of Chemie im Kontext) Co-operation between teachers and researchers and between school administration, teachers´ training services and researchers (different perspectives and expertise)
Background and theoretical framework of our pd approach	Different organisational structures of teacher training courses Approach of learning communities / communities of practice Approaches of situated learning, context-based learning Empirical results and theories on teaching and learning (e.g. quality of instruction, design of tasks) Empirical results and theories about correlations between teachers´ beliefs and their planning and realisation of teaching as well as their attitudes towards co-operation
Criteria for evaluation (research based, statistics,	Change of classroom activities (use of workshops offers in classroom) Changes and individual judgement of co-operation in school departments

Additional Prospective Collaborative Projects, Group 4

based, statistics, observations, …)	Evaluation of classroom-work by teachers and students Conceptual understanding of students Changes in teachers´ attitudes / beliefs about "chemistry and good chemistry teaching and learning" Practicability of teachers´ training approach in different school systems

Additional Prospective Collaborative Projects, Group 4

Working Group PISA 2006
German-U.S.-International Workshop

Name and Institution

Peter Labudde, University of Bern, Abteilung fuer das Hoehere Lehramt

Sketch of research already carried out

1) TIMSS - Switzerland (1993-1997)

- Focus: analysis of the culture of physics instruction in the upper secondary level
- Theoretical framework: moderate constructivism
- Research methods: questionnaires for students (in addition to the international questionnaire), interviews with teachers
- Results: see Labudde, P. (2000): Konstruktivismus im Physikunterricht der Sekundarstufe II. Bern: Haupt, 446 pages.

2) The culture of learning and teaching physics: a video study (2003-2005)

- Focus: physics instruction, grade 9, learning process, instructional methods, context of physics instruction, bi-national study Switzerland - Germany
- Theoretical framework: in some parts based on the theoretical framework of the TIMSS-video study in mathematics and its following studies
- Research methods: video taping, questionnaires for students and teachers, interviews with teachers
- Results: work in progress (the start of this study was only in January 2003)

3) Integrated Science at the upper secondary level: broadening the spectrum of tests and evaluations (2003-2006)

- Focus: testing, evaluation, grading in integrated science at the upper secondary level
- Theoretical framework: see www.ahl.unibe.ch/forschung
- Research methods: document analysis, questionnaires for students and teachers, interviews with teachers, action research
- Results: work in progress (the project will start only in August 2003)

Sketch of planned research

- Aims: enlarging the spectrum of competencies and their evaluation in physics instruction and in integrated science instruction; development of new tests and further instruments; comparison of the culture of physics instruction in the U.S., Germany and Switzerland
- research methods: questionnaires, tests, performance tests (similar to the TIMSS Performance Test, but based on virtual computer based 'experiments')

Additional Prospective Collaborative Projects, Group 4

Cooperation already running

- In the second project (video study) cooperation with the IPN in Kiel
- In other projects of our institution cooperation with other universities in Switzerland and abroad

Further comments

- I would appreciate, if our institution from Switzerland could participate in the planned German-U.S. research projects
- I am looking for grants here in Switzerland, e.g. Government and / or Swiss National Science Foundation.

Bern, July 10th, 2003 Peter Labudde