EVALUATIONAL RESEARCH ON A VIDEO-BASED IN-SERVICE MATHEMATICS TEACHER TRAINING PROJECT - REPORTED INSTRUCTIONAL PRACTICE AND JUDGEMENTS ON INSTRUCTIONAL QUALITY

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In this study, we concentrated on aspects of evaluational research on a video-based in-service teacher training program with more than 30 participating upper secondary mathematics teachers. As the program aimed at encouraging the teachers in improving cognitive activation in their classrooms, the evaluation focused both on components of the teachers’ professional knowledge and on indicators for implementation in instructional practice. The results indicate that teachers modified their perception of instructional situations and reported to have introduced more student-centered work on activating tasks in their classrooms.

THEORETICAL BACKGROUND

Research on impacts of in-service teacher training projects often concentrates on four levels of observation (cf. Lipowsky, 2004; Kirkpatrick, 1979): The first level of observation includes feedback by participating teachers e.g. with respect to the usefulness of the training project or self-reported changes in their classrooms. On a second level of observation, the development of professional knowledge can be analysed. The third level includes ratings of the teachers’ actions in the classroom by external observers. Finally, there are studies treating possible impacts of teacher training programs on student achievement and other data linked to the learners, which can be identified as a forth level of observation. These four levels of observation are linked to the question to what extent teachers enrolled in an in-service teacher training project implement its contents in their professional and instructional practice. For implementation, professional knowledge and instruction-related beliefs seem to play a mediating role: Professional knowledge is likely to be a prerequisite for experimenting with contents of the in-service teacher training project in their classroom practice. If a teacher, for instance, perceives a contradiction between her or his instruction-related beliefs and contents of the teacher training, she or he might react differently to the teacher training project than teachers who see their beliefs in line with the aims of the training. This is why teacher training projects often focus on the implementation of improved instructional practice and the development of professional knowledge.

A practice-relevant domain of professional knowledge concerns judgements on instructional quality (Clausen, Reusser & Klieme, 2003) in classroom situations. Improving the teachers’ ability to judge on instructional quality might have an impact on instructional practice, as the decision-making by teachers involves general, situa-

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tion-specific, and content-specific cognitions and beliefs (Malara, 2003; Escudero & Sanchez, 1999). In particular, this seems to be the case for decisions teachers make in instructional classroom situations. The theoretical background for components of professional knowledge investigated in this research project (e.g. Shulman, 1987; Leinhardt & Greeno, 1986) has been described in more detail in Kuntze & Reiss (2005). In the following, we concentrate on contents and aims of a teacher training project addressing professional knowledge and classroom practice.

The in-service teacher training project

The findings of the TIMSS Video Study (Baumert et al., 1997) were a starting point for the in-service teacher training project, which was subject to the evaluational research of this study. These findings revealed a teaching script typical for German classrooms that can be described as a teacher-centered interaction marked by questions and tasks of a rather low level of complexity. Challenging and cognitively activating tasks were often lacking, and the students had little time to develop answers containing several steps of a solution. For the special case of lessons on geometrical proof, we could replicate these results in an own study (Kuntze & Reiss, 2004). Under the condition of the teaching script, meta-knowledge on the subject was not emphasised and the students were likely to encounter difficulties in building up mathematical concepts, in the particular case the concept of mathematical proof (cf. Reiss, Klieme & Heinze, 2001). Based on these findings, three measures were identified that might improve cognitive activation as an important dimension of instructional quality (Clausen, Reusser & Klieme, 2003):

- Fostering argumentation processes among the students in the classroom interaction can enable them to develop multi-step problem solutions in challenging situations (cf. Reiss, Klieme & Heinze, 2001).
- Using mistakes in the classroom for working on conceptual understanding and as opportunities for argumentational exchange can be used to provide cognitively activating and authentic learning opportunities (cf. Heinze, 2005).
- Together with the measures above, more challenging tasks like those suggested in standards should be addressed. Additional learning environments focusing on conceptual understanding and requiring multi-step individual or cooperative student work could help to contribute to improve cognitive activation.

As these possible measures are well in line with the goals of recently introduced German standards for mathematics education, the aim of the in-service teacher training project was to encourage teachers to introduce changes in their classrooms in accordance with these goals. The teacher training project had two components: The first component consisted of video-based discussions of instructional situations. These discussions should help the teachers to improve their observation of instructional quality and to consider alternative teacher actions. Additionally, the participants were encouraged to make experiments in their own classrooms, trying to provide more cognitively activating instructional situations. The second component of the teacher
training focused on the development and implementation of a student-centered, cooperative learning environment on the in-depth understanding of a mathematical concept. Written argumentation of the students was part of this learning environment.

We expected that, before the training project, the teachers’ instructional practice as well as their instruction-related beliefs were consistent with the teaching script revealed in the TIMS Video Study. Furthermore, we tried to find out whether changes of such “traditional” beliefs and practices towards more appreciation of fostering cognitive activation, argumentation and discourse took place during the project.

RESEARCH QUESTIONS

The study aims at providing evidence for the following research questions:

(i) How do the teachers describe their instructional practice? Is there evidence in the teachers’ self-reported instructional practice, whether they implemented contents of the teacher training project, in particular of the video-based work?

(ii) Is there a development of the teachers’ situation-specific professional knowledge about instructional quality in classroom situations? Are such changes consistent with the results concerning the teachers’ reported implementation in the classroom?

METHODS AND SAMPLE

The evaluation of the teacher training project concentrated on two levels of observation: In the first place, judgements of the participating teachers and their perceptions of their own instructional practice were included. We used an instrument developed in the group of Eckhard Klieme (DIPF, Frankfurt a. M., Germany). Secondly, the evaluation focused on the development of situation-specific and more general components of professional knowledge (cf. Kuntze & Reiss, 2005).

Figure 1: Structure of the in-service teacher training project and evaluational design

In this study, we concentrated on data of 32 German participants who answered paper-and-pencil questionnaires both before and after the training project (cf. fig. 1). The video-based instrument on situation-specific professional knowledge concerned introductory lessons on geometrical proof. In this questionnaire, the teachers were
asked to give judgements on two classroom situations: Video A showed patterns of interaction marked by argumentational exchange and cognitively activating discourse between the students and the teacher, whereas video B could be characterized as a teacher-centered interaction comparable to the dominant teaching script in Germany. According to our research questions, we will report results from questionnaires concerning reported instructional practice and experiences in the phases of implementation. For situation-specific professional knowledge, we will analyse additional data gained with the video-based instrument for judgements on instructional quality.

RESULTS

The scales of the questionnaire on instructional practice shown in table 1 were confirmed by a factor analysis. Table 1 also contains sample items for the scales.

<table>
<thead>
<tr>
<th>Scale</th>
<th>Sample item</th>
<th>Number of items</th>
<th>Cronbach’s α before / after the training project</th>
</tr>
</thead>
<tbody>
<tr>
<td>teacher-centered interaction (German script)</td>
<td>“... I am talking, asking questions and some students give answers.”</td>
<td>2</td>
<td>.50 / .74</td>
</tr>
<tr>
<td>presentation by teacher</td>
<td>“... I am presenting, while the students are listening.”</td>
<td>2</td>
<td>.76 / .63</td>
</tr>
<tr>
<td>Student-centered work on activating tasks</td>
<td>“... I have the students finding out on their own about solutions to challenging problems.”</td>
<td>4</td>
<td>.69 / .71</td>
</tr>
<tr>
<td>Open organisation of classroom work</td>
<td>“... the students are working on different projects.”</td>
<td>3</td>
<td>.43 / .72</td>
</tr>
<tr>
<td>Students presenting their learning results</td>
<td>“... I have the students presenting things they have worked out before in groups or individually.”</td>
<td>2</td>
<td>.63 / .83</td>
</tr>
</tbody>
</table>

Table 1: Scales on self-reported instructional practice.

<table>
<thead>
<tr>
<th>Scale</th>
<th>Sample item</th>
<th>Number of items</th>
<th>Cronbach’s α Phase 1 / 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>focused observation</td>
<td>“I have observed the cognitive activation of my maths instruction with more attention than before.”</td>
<td>3</td>
<td>.89 / .84</td>
</tr>
<tr>
<td>experimenting / cognitive activation</td>
<td>“I have remarked changes in my mathematics instruction, that I attribute to my experimenting in the classroom.”</td>
<td>5</td>
<td>.83 / .88</td>
</tr>
<tr>
<td>using opportunities for learning from mistakes and fostering argumentational exchange</td>
<td>“I have observed that the intensity of argumentation in the classroom interaction was increased by the measures I took.”</td>
<td>4</td>
<td>.73 / .78</td>
</tr>
</tbody>
</table>

Table 2: Scales concerning experiences in the phases of implementation.
For the questionnaire on experiences in the phases of implementation, reliability data and sample items for the scales related to the implementation of the video-based teacher training are given in table 2.

The means for the scales concerning instructional practice reported by the teachers are shown in figure 2. The values before the training project indicate that the German teaching script revealed in the TIMS-Study seems to be dominant in the reported instructional practice as well. In comparison with the data collected after the training project, there is a significant change for the scale “student-centered work on activating tasks” (T=-3.25; df=31; p<0.01; d=0.45). As an example for changes on the item level, the participants reported to use group work of their students more often than before the training project (T=-2.88; df=31; p<0.01; d=0.49).

![Figure 2: Reported instructional practice](image)

The indicators for implementation linked to the video-based work of the teacher training presented in table 2 can provide further evidence (cf. fig. 3). The participating teachers were asked to what extent they observed their own practice and whether their focused experiments in the classroom improved the instructional quality in their classrooms. For two of the three scales, there was a highly significant change indicating improved implementation activities of the participating teachers in the second phase of implementation. However, the means reflect rather moderate judgements in general.

![Figure 3: Reported implementational activities concerning classroom interaction](image)
As the scale “student-centered work on activating tasks” (cf. table 1 and fig. 2) seemed very relevant for the aims of the teacher training project, we focused on developments in that domain. We verified whether the indicators for implementation linked to the video-based work presented in figure 3 were linked to the findings in figure 2: There were significant correlations between the pre-/post-difference of “student-centered work on activating tasks” and “fostering argumentation/learning from mistakes” (both questionnaires; .40* resp. .36*) as well as “experimenting/cognitive activation” (second questionnaire; .38*). This means that teachers, who said to have implemented the contents of the video-based work in their classrooms more intensively, also tended to perceive a higher increase in student-centered work on activating tasks in their classrooms.

For the development of situation-specific professional knowledge concerning instructional quality, we had observed rather diverging judgements on instructional quality of the videotaped classroom situations before the beginning of the in-service teacher training (cf. Kuntze & Reiss, 2005). As we liked to observe especially the development of professional knowledge of teachers holding more “traditional” beliefs with respect to the dominant German teaching script, we distinguished between “traditionally oriented” teachers and “teachers favouring discourse” using a cluster analysis (fig. 4). On the base of judgements on instructional quality before and after the project, a certain convergence of the judgements of the two clusters can be stated. Additionally, especially the cluster of the rather “traditionally oriented” teachers rated video A more positively after the project. According to our approach, this videotaped classroom situation was marked by a relatively strong argumentational exchange. Consequently, the participants’ perceptions and opinions related to video A were very important for us as indicators for the impacts of the video-based discussions in the teacher training project. For instance, when asked to compare the videotaped classroom situations to their own instructional practice, the two clusters show the developments represented in figure 5.
After the training project, the participants report their own instructional practice to be closer to video A than before the project. Taking a look at possible interdependencies between the comparison of video A to the teachers’ own instructional practice and indicators for implementation, there are significant correlations: The pre-/post-difference of “student-centered work on activating tasks” correlates with the perceived similarity of the own instructional practice to the content and task structure of video A (.40*). Moreover, three of the six variables in figure 3 show significant correlations to the perceived similarity of the own instructional practice to video A (correlations ranging from .39* to .48*).

INTERPRETATION OF THE RESULTS AND IMPLICATIONS FOR THE THEORETICAL AND PRACTICAL CONTEXT

Comparing the results of the teachers’ reported instructional practice to the results of the TIMSS Video Study, the values before the training project give a plausible outline of what might happen in the participants’ classrooms. After the training project, especially the domain “student-centered work on activating tasks”, which was very relevant for the aims of the project, appears to have been fostered. Taking a closer look, there are interdependencies with other indicators for implementation and developments of situation-specific professional knowledge that reveal to the video-based work in the project. Also, the higher perceived similarity of the participants’ own interactional patterns to the situation in video A might be interpreted as further evidence for changes in the participating teachers’ classrooms.

However, the results should be interpreted carefully. The data do not allow causal implications like: “Developments in professional knowledge have caused changes in the reported instructional practice“. The correlations found in the study might just reflect simultaneous developments of the enrolled teachers in the different domains.

The changes in situation-specific professional knowledge and reported instructional practice were generally rather moderate. The findings might indicate that the participating teachers acquired additional alternative possibilities of conceiving mathemat-
ics instruction and acting in the classroom. Hence, two of the impacts of the teacher training project might have been enriched patterns of perception for instructional situations and diversified possibilities of acting in the classroom.

References


