Rainer Bromme

Teachers' Recall of Students' Difficulties and Progress in Understanding in the Classroom

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Abstract

In order to teach successfully, teachers must pay attention to the problems and mistakes of their students. In accordance with this need, cues are important for teachers' decisions. However, how is this related to the students' relationship to the subject matter content which is the main concern of learning in schools and what is the nature of the students' cues which are considered? It is unclear what teachers remember from instructing students.

By studying teachers' recall about their students' difficulties and progress in understanding we investigated this question. Mathematics teachers' lessons were tape-recorded. After the lessons the teachers were asked which of their students' problems and progresses in understanding they remembered. The results in general showed little recall for cases of progress and problems. Few students were individually named, but there was a detailed recall of contributions that were of strategic importance for the instructional flow. It was the contribution of the notional 'collective student' that were recalled.

These findings are explainable if one takes into account the teacher's task of knowledge presentation. During teaching the teacher has to focus his/her thinking on the development of the subject matter and not on the learning of the individual students. But the subject matter is not just presented by the teacher, but also by the students. Thus misunderstandings in the lesson became objects of teaching. Such problems and progresses were recalled.

Consequences for research models of interactive decision making are discussed, which result from this picture of the teacher's task.

This chapter describes teachers' perceptions and explanations of their students' understanding in the classroom situation. We begin with the assumption that students' understanding and learning of subject matter in the classroom forms an important object of teacher activity: One could almost say that it is the core of the teacher's real task. (1) As well as providing a review of our own and other studies, inferences will be drawn about how teachers' knowledge is in fact organized. We hypothesize that teachers' practical knowledge consists not so much of an abundance of facts that one knows and takes into account as a teacher, but of the relations and connections between those facts. This hypothesis could be formulated in another way: The essence of practical

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knowledge concerns the relations between factual situations, persons, and objects. Although this may appear somewhat obvious, it has not previously been acknowledged by researchers, who have too long been concerned with neatly sorting teachers’ thoughts into different categories. One essential achievement of teachers, namely the production of mental relationships, thus does not fall into the researchers’ field of vision. We therefore aim to demonstrate that the researcher’s categories have other boundaries than the teachers’ cognitive units. In practical knowledge, the world of the classroom is not categorized in terms of the variables traditionally used by researchers.

1. Research on teachers’ views about students’ understanding

Although the encouragement of students’ understanding is probably the most important task of the teacher, there have been very few investigations of teachers’ perception and interpretation of understanding in the classroom. There are, however, many studies on teachers’ general perceptions of students (e.g. Hofer, 1981; Brophy & Evertson, 1982). Although these studies differ in some details, they demonstrate that the students were perceived according to traits and behaviors that were functional for the teachers’ tasks (Cooper, 1979).

The validity of teachers’ judgments has also been investigated. Teachers’ judgments have been found to be relatively valid both in terms of independent observations and predictive validity. However, judgments were only valid when the teachers had the opportunity to get to know the students they were to judge, and when asked to judge concrete performance or behavior. In other cases, stereotypes were applied that were less valid (Wang, 1973; Pedulla, Airasian & Madams, 1980; Leinhard, 1983; Natriello & Dornbusch 1983).

Why do so few investigations focus upon teachers’ understanding of their students in the classroom? In the early days of research into teachers’ views of their students, it was assumed that teachers’ concepts of their students were situationally invariant. As long as one supposed a stable number of cognitive categories by which students are perceived (for a long time, a total of 3-5 categories was considered empirically proven), there was no need to describe situation-specific teacher perspectives on their students. Since then, it has been shown that the fixed number of student types is possibly an artefact of the data analysis procedure (factor or cluster
analysis; e.g., Oldenburg, 1986), and that the differentiation of the teacher's view of students depends on the situation in which students are perceived; e.g., Morine-Dersheimer, 1978/79.

Both methodological and cognitive psychological reasons support the idea that one should investigate the teachers' situation-specific views of students. Hofer (1986) refers in this context to the schema concept. The assumption that the actions of teachers are structured by means of schemata implies a situation-specific differentiation of the teachers' perception of students. The basic ideas of the schema construct are that knowledge of a situation enables one to perceive similarities between situations, and that this knowledge can differ in detail. To have a schema at one's disposal means that one has these different degrees of knowledge available that can be activated according to the situation. This has been shown with well-known examples of schemata such as the Restaurant Schema.

Our question on teachers' recall of learning progress and problems in understanding aims to investigate teachers' situation-specific views of their students by choosing one type of situation; classroom instruction in mathematical tasks.

Empirical investigations of teachers' views of understanding in the classroom

In order to analyze teachers' situation-specific views, we made two specifications of the situation. We investigated the teacher's recall of students in the classroom (and not in any other situation) and regarding their understanding (and no other behavior).

Studies of teachers' interactive decision making are of particular interest for our question, because they focus on teachers' thinking in the classroom and are therefore concerned with the first specification. However, since they attempt a general comprehensive description of teachers' interactive thinking, they omit specific reference to teachers' thinking about students' understanding. One exception to this will be mentioned later.

The available studies suggest that the student and his or her activities in the classroom occupy a large space in the teacher's thinking during the lesson. A review of the content analyses from six studies using video-stimulated recall (VSR) reveals an amazingly high level of agreement (Clark & Peterson, 1986). According to these studies, between 40 and 50% of all considerations are related to students, and about 20 to 30% are related to the instructional process. The subject matter is only mentioned between 5 and 14% of the time, and in some of the studies it is not even granted a special category. Most of the references concerning students
are related either to their learning process or to their behavior in the classroom (e.g. McNair & Joyce, 1979).

It is quite remarkable that 'subject matter' is so rarely mentioned as a cue that precedes decisions, as the students’ learning process is concerned with the content. This also surprises us because we have found different results by two studies in which we investigated teachers’ retrospective explanations for their students’ mastering of tasks. A large part of the teachers’ explanations concerned operations and knowledge of the subject matter. One could almost say that the structure of the subject matter permeated the teachers thinking about their students (Bromme & Juhl, 1985; Bromme & Dobslaw, 1986a). Although these studies were not concerned with considerations during the lesson, they raise the question whether the subject matter is really so seldom present in the teachers thinking in the lesson as suggested by the studies on interactive decision making.

The differentiations made in the studies of interactive decision making between thoughts about students vs. thoughts about the subject matter vs. thoughts about the learning process may possibly contribute to the fact that teacher’s considerations of understanding apparently occur so rarely. Thus Clark and Peterson (1986, p. 269) note that the teacher’s statement “I thought after I explained it to her, I didn’t make that very clear” was rated as an utterance concerning instructional process, while, in contrast, the statement “I was thinking they don’t understand what they are doing” was labeled as an item concerning the student. However, one can interpret both statements as indicators of a situation that is concerned with understanding, in which the teacher considers the relation between subject matter and student.

This interpretation is also relevant when one considers the cues teachers attend to in making decisions. A study by Fogarty et al. (1983) differentiates student cues in terms of deficient responses, initiations (i.e. unrequested student activities), mistakes, and unsuitable level of attention. Unfortunately it is not clear whether the first two cues to which the teacher reacts relate only to the subject matter. Nevertheless, the relatively high frequency of mistakes as cues for the choice of teachers’ actions is again an indicator that nonroutine action is particularly related to the students’ difficulties with the subject matter.

We know from these studies that students’ cues are frequently mentioned as antecedents of teachers’ decisions, but what does this mean? The meaning of these findings is blurred due to the previously mentioned problem that little attention has been paid to learning and understanding in the classroom. Therefore, what is observed in students in the classroom, which students
are observed, and in what way these observations take into account learning and understanding remain open questions.

The study by Shroyer (1978), however, presents a few provisional answers. This study will be reviewed in more detail as it is one of the few investigations that have explicitly investigated teachers' perceptions of the process of understanding.

Shroyer investigated whether mathematics teachers regard the problems and difficulties of their students during classroom interaction as being sufficiently problematic to react upon them. She also investigated whether teachers utilize sudden unexpected insights from their students. This research question is notable, since it recognizes the way of coping with problems and students' insights as being a part of the teacher's work. By using learning episodes and student mistakes to uncover cognitions, Shroyer avoids breaking up verbal data into distinct content categories of student and subject matter.

She videotaped two mathematics lessons given by each of three 4th. to 6th. grade teachers, and coded them in order to assess 'student occlusions', i.e., situations in which either a false or unrequested student contribution pointed out a problem or in which an unexpected insight occurred. In the three teachers' lessons, there were (in each block of two lessons) between 49 and 217 such situations.

After the lesson, a stimulated recall session was held. The teachers were asked to "... recall thoughts, feelings, or decisions that occurred while teaching the mathematics lesson" (p.50). If the teachers themselves offered no comment, the researcher cautiously probed for teachers' recall of thoughts during 'student occlusions' and teachers' 'elective actions'. Shroyer then investigated how many 'student occlusions' were also viewed by teachers as being problematic for their teaching; i.e., whether the teachers recalled these situations during the lesson as causing them cognitive difficulty or emotional discomfort. Only an average of 3% of student errors or sudden insights were regarded by teachers as being problematic for their teaching. The author states that this total of 3% somewhat underestimates the real number because the student errors mentioned by teachers were noted as examples of pervasive teaching problems. Nevertheless, the proportion of all student errors and insights which gave rise to further thinking was surprisingly small. The study did not clearly state how many of the observer-coded errors were perceived by the teachers, but showed that only a small percentage of 'student cues' led to deliberate decisions on further actions. This leads us to ask what is the nature of the students' cues that have been reported in other studies as being so important for teachers' interactive decision making. It is also unclear how many student problems are so important that they are remembered by teachers at all.
2. An empirical study on teachers' recall on students' understanding in mathematics teaching

Our study was concerned with the following questions:
- - - - How many and what problems and progress in students' understanding are remembered by teachers if they are interviewed immediately after the lesson?

If it should emerge that there is little memory of instances of understanding and of problems, then we must ask:
- - - - Who or what is in the focus of the recall?

Data collection

The study is based on interviews that were carried out subsequent to classroom observations. In this section, we will first describe the data collection in detail, and then we will explain why interviews were conducted rather than following, for example, a VSR design.

As part of a larger project on the teaching of probability in secondary schools, we observed the teaching behavior of mathematics teachers and interviewed them after the lessons. In the classroom observation, student participation was recorded and field notes were taken on the course of the lesson. All teachers taught the same subject matter, namely an introductory course on probability. For this, they were given curriculum material developed by the project team. This consisted of a system of mathematical tasks, out of which the teachers could freely select the tasks of their choice.

The interviews were carried out in the teachers' next free lesson or, at the latest, before their lunch break. At the beginning of the interviews, the tasks that had been used in the lesson and the lesson phases (individual work, group work, discussion of homework, etc.) were entered on a sheet of paper in their order of occurrence. Then questions were presented on teaching goals and the desired motivational effect of the methods the teacher had chosen. After the course of the lesson had been called into memory by these questions, the questions relevant to our investigation were presented, namely:
Do you remember any subject-oriented learning progress made by individual students or groups of students, i.e., single questions or comments that made it clear to you that the student or students had learnt or understood something? (Question on progress in understanding)

Do you remember any subject-oriented mistakes or misunderstandings from individual students or groups of students, i.e., single questions or comments that made it clear to you that the student or students had made a mistake or misunderstood something? (Question on problems in understanding)

Additionally, answers to a third question were included in the analysis:

Were there deviations and differences from your plan, and why? (Question on the plan of the lesson)

The interview was constructed so that the teacher had the opportunity to recall the course of the lesson. The accompanying questions attempted to ensure that observations on students' understanding would not be repressed because teachers found the communication of other matters to be more important. The interviewer's classroom observation and the tape recording that was made of the lesson prevented any intentionally fictional reports from being given. The teachers we interviewed had to assume that all the events they reported might also have been observed by the interviewer. Classroom observation by the interviewer was also important as it produced a shared background experience that made it unnecessary for the teachers to describe the setting of the events they had noticed. It is a rule of conversation that only that which cannot be presupposed by the listener, is communicated (Grice, 1975). Therefore we could also analyze the verbal structure of the reports without them being buried in descriptions of the settings.

The construction of the interview was designed so that recall of individual students' understanding was encouraged as much as possible. However we did not use lists of names in our questioning, as this would have destroyed the natural structure of the recall. We were much more interested in keeping the interview as freely structured as possible, so that we could then analyze the structure of the reports (What was recalled? What was the sequence of recall? How many students were recalled?).

Digression: A justification for the method of data collection

The method of data collection will be discussed in some detail as we did not use the VSR method that is normally applied in such studies (Calderhead 1981). In carrying out an interview that was only backed up by a single written recording of the course of the lesson, we naturally did not obtain such a complete picture of the perceptions and considerations in the classroom as would have been provided by the joint viewing of a video recording. However, it is likely that only those events would be recalled that were subjectively important for the teacher, and to which he or she paid conscious attention during the lesson. In our study, this has one advantage compared to the
VSR design, namely that the teacher is unable to make new discoveries and interpretations of students' mistakes, based on the viewing of the videotape. This can occur without teachers having any conscious intent to deceive.

On the other hand, one must be aware that the semantic integration effect causes a blurring between the perceptions of understanding in the classroom and the teacher's existing knowledge. The semantic integration effect refers to the fact that new information is integrated into old knowledge, and that it is often no longer possible to separate the new information that was actually perceived (Bransford & Franks, 1971). We must therefore assume that the teachers' reports can, in some circumstances, distort the actual events. However, it is assumed that this subjective structuring of observations on understanding that teachers perform is not an arbitrary process, but reflects the teachers' concepts of understanding. In this sense, the teachers' recall on their students presents us with information about the teachers themselves. In other words, the alteration of events through memory processes is not a hindrance to our investigation. Thus, with our method we do not obtain the immediate perceptions of the teacher during the lesson, but an application of existing knowledge to the classroom situation. However, this is exactly what we wished to reveal with our questions.

For this purpose, it was also important that the interview was designed to produce the minimum amount of anxiety in order to avoid a distortion of the answers. The teachers had already met the interviewer on several previous occasions, and it was clearly pointed out that we were interested in the teachers' experiences and were not trying to tell the teachers what to do. In addition, the interviews were designed to allow the teacher much freedom in guiding the course of the conversation. With these methods, a confidential relationship with the teachers was achieved.

Subjects

Interviews with 19 teachers were analyzed in this study. The teachers taught either 5th, 6th, or 7th grade (students' age between 11 and 14 years) in one of five different comprehensive schools. The average length of professional experience was about eight years. All of the teachers volunteered for the study. Each teacher was observed and interviewed on at least four occasions, in addition to earlier 'warm up' observations. One lesson per teacher was chosen that occurred relatively early in the series, as at this stage the lesson content was most similar in all classes.

Data analysis

The answers to the questions were transcribed, and comments made by the teachers on other occasions during the interview that concerned the learning progress and problems in understanding of their students or class were also included in the analysis. For the content analysis, a system of categories was formed for events, protagonists, and causes, loosely based upon concepts from story understanding research. These categories show similarities to the most important elements of stories (Thorndyke, 1977). Our interviews had in fact requested verbal presentations of short stories about understanding. As verbal protocols are texts, it is at least heuristically meaningful to relate the construction of the content analysis to the instruments from research into the production and understanding of texts (Bromme, 1983).
In our study, we used the story structure of protagonist, event, and cause to provide us with an instrument to identify the relation of subject matter, students, and their activities. In other words, it is a first step aimed at overcoming the above criticized a priori separation of relations during the analysis of verbal data.

Description of the content analysis system

In the classification of the protagonists, a differentiation was made between specific named students, a specific exactly defined group of students (e.g., those sitting together at one table), and the entire, or majority of, the class (which is what the teacher means when he or she talks about the entire class). Additionally, many answers contained no reference to a protagonist and only gave unspecific descriptions of difficulties. A separate category was prepared for such answers.

The categories for events describe individual activities in the learning and application of concepts and procedures in probability, the construction of which is based on a rational task analysis of mathematical tasks. Operating with subject-related concepts requires either observable activities (for example: Drawing up a table for a tree diagram is difficult for the students) or mental inferences or insights (an example: Comparing chances between different random generators is difficult for students). Eleven such subject-related categories were available which, after coding, were summarized under the two headings mathematical activities and mathematical insights. There were additionally some instances of organizational events (for example: the occurrence of administrative tasks).

A large proportion of the answers contained an element that could be regarded as the cause of the event. To cover causes in the analysis, a list was constructed that included the important variables of the instructional process taken from recent research models of teaching and learning; for example, variables that refer to student characteristics, the task, and the instructional quality. The concepts and skills in the lesson unit were listed in order to record the teachers' mentionings of the subject-related knowledge and abilities of their students as causes of understanding. These items were summarized according to their content before the quantitative analysis was performed.

Table 1 presents the revised list of all categories. All these categories about events and causes could be used to record cases of successful understanding or difficulties as well as deviations from the lesson plan.

Rating was performed by a coder who was familiar with the content of the lesson unit. Each statement in which at least one cause or event was given was regarded as one coding unit. Then the protagonist for each unit was ascertained. Six interviews were selected at random and coded by a second rater in order to assess rater reliability. Agreement between raters was 79%, which is sufficient for our descriptive purposes.

3. Results of the interview study

In reply to the question on the progress of understanding of individual students or groups of students, there was a total of 83 cases; an average of 4.4 per teacher and 45 minute lesson. The protagonists named in these cases were: 64% named individual students, 23% the entire class, and 13% groups of students. Table 1 gives the frequencies for all teachers.
<table>
<thead>
<tr>
<th>Protagonist</th>
<th>Deviation from lesson plan</th>
<th>Progress in understanding</th>
<th>Problems in understanding</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>frequency</td>
<td>percentage</td>
<td>frequency</td>
</tr>
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<td>18</td>
<td>-</td>
</tr>
<tr>
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<td>10</td>
<td>11</td>
</tr>
<tr>
<td>Entire class</td>
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<td>62</td>
<td>19</td>
</tr>
<tr>
<td>Named student</td>
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<tr>
<td>Total</td>
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<td>100</td>
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<table>
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<th>Event</th>
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</thead>
<tbody>
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<td>27</td>
<td>30</td>
</tr>
<tr>
<td>Task not treated</td>
<td>4</td>
<td>10</td>
<td>-</td>
<td>-</td>
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<tr>
<td>Organizational event</td>
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<td>-</td>
<td>-</td>
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<td>Subject matter activities</td>
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<td>28</td>
<td>35</td>
</tr>
<tr>
<td>Subject matter insights</td>
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<td>31</td>
<td>28</td>
<td>35</td>
</tr>
<tr>
<td>Total</td>
<td>39</td>
<td>100</td>
<td>83</td>
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<table>
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<th>Cause</th>
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<tbody>
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<td>26</td>
<td>39</td>
<td>47</td>
</tr>
<tr>
<td>Task difficulty</td>
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<td>10</td>
<td>4</td>
<td>5</td>
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<tr>
<td>Students' knowledge and skills</td>
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<td>-</td>
<td>8</td>
<td>10</td>
</tr>
<tr>
<td>Quality of teacher planning</td>
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<td>10</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>and knowledge</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pacing and course of the lesson</td>
<td>9</td>
<td>23</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Instructional quality</td>
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<td>20</td>
<td>9</td>
<td>11</td>
</tr>
<tr>
<td>Students' giftedness</td>
<td>-</td>
<td>-</td>
<td>6</td>
<td>7</td>
</tr>
<tr>
<td>Students' engagement</td>
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<td>5</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Self-confidence or anxiety of</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>students</td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Motivation of students</td>
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<td>3</td>
<td>13</td>
<td>16</td>
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<tr>
<td>Global characterization</td>
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<td>1</td>
<td>1</td>
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<td>(good vs. bad student)</td>
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</tr>
<tr>
<td>Total</td>
<td>39</td>
<td>100</td>
<td>83</td>
<td>100</td>
</tr>
</tbody>
</table>

Table 1: Frequencies of protagonists, events and causes for all teachers (N = 19)
The question on problems of understanding produced 69 cases; an average of 3.6 per teacher. The protagonists were: 56% individual named students, 28% the entire class, and 16% groups of students.

Teachers named 39 cases in reply to the question on deviations from the lesson plan. The protagonists named were: 62% the entire class, 10% named individual students, and 10% groups of students. For the remainder, no protagonist was named and only the events were described.

The mentioning by name of individual students per teacher was on average only 3 for the question on progress in understanding (one teacher mentioned a maximum of 6 students). There were very few individual differences. For the question on problems in understanding, each teacher mentioned on average 2 students by name, with a maximum of 6 students by 2 teachers. Individual differences were larger in this question; 8 out of the 19 teachers mentioned no individual student by name.

Spearman rank correlations were calculated over the 19 teachers in order to determine whether there were interrelations between the frequencies of responses to the three questions. Teachers who named a lot of cases in the question on successful understanding also named a relatively high number in the question on problems. The correlation was: \( r = .65 \) (\( p < .001 \)). However, the frequency of cases in both questions correlated negatively with the mentioning of deviations from the lesson plan. The correlation was \( r = -.41 \) (\( p < .05 \)) between number of cases in the question on the lesson plan and the number of cases in the question on understanding problems. Thus our teachers differed according to whether they tended to remember most problems in connection with the general course of the lesson and its deviation from their plan, or remembered problems in connection with the questions on understanding progress and difficulties.

What events and causes are named?

The most frequent events by problems in understanding concerned students' difficulties with observable subject matter activities. These were twice as frequently mentioned as events concerning insight into the subject matter. These observable activities that turned out to be a problem for the students were, for example, drawing up a tree diagram for the possible results of dice throws, or listing the frequencies of various two dice combinations in tables.

The question on understanding progress gave a different result, in that subject matter insights were as frequently mentioned as observable activities. A subject matter insight event was, for example, the comparison between different random generators (dice vs. coin tossing). The most
frequent deviations from lesson plan events were also students’ activities and insights into the subject matter. In addition, organizational events or the fact that the task could not be treated were events which were recalled as deviations from the teacher’s plan.

The most frequently stated cause of events involving problems of understanding was the quality of instruction followed by student engagement and students’ knowledge and skills. In reply to the question on understanding progress, the most frequently named cause was students’ motivation followed by teachers’ instructional quality and students’ knowledge and skill. The frequencies for instructional quality and students’ knowledge and skill were similar by both questions. They differed with respect to student engagement, which was more frequently named as a cause of problems, and student motivation, which was more frequently named as a cause of understanding progress.

Responding to the question on lesson planning, the most frequently named cause was, "pacing and course of the lesson other than planned". This category does not really describe anything more than the actual question, namely the difference between the plan and the lesson. Nevertheless, this was how the question was answered. One might conclude from this that teachers experienced the lesson, its pacing, and its course as having an independent autonomous 'gestalt'. This 'independent momentum' that a lesson can develop is perceived as being the cause of a deviation from the lesson plan. Besides this, the instructional quality was frequently mentioned, indicating that the teachers see themselves as being responsible for the deviation from the lesson plan.

In which events are either individual students or the entire class named as protagonist?

This question is of particular interest for progress and problems. Table 2 presents the events classified according to protagonists.
<table>
<thead>
<tr>
<th>PROTAGONIST</th>
<th>No event (but cause mentioned)</th>
<th>Subject matter activities</th>
<th>Subject matter insights</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>frequency</td>
<td>percentage</td>
<td>frequency</td>
</tr>
<tr>
<td>Progress in understanding</td>
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<tr>
<td>Not specified</td>
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<tr>
<td>Group of students</td>
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<td>Entire class</td>
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<td>15</td>
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<td>Named students</td>
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<td>100</td>
<td>28</td>
</tr>
<tr>
<td>Total</td>
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<td>Problems in understanding</td>
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<td></td>
</tr>
<tr>
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<tr>
<td>Group of students</td>
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<td>14</td>
<td>5</td>
</tr>
<tr>
<td>Entire class</td>
<td>19</td>
<td>86</td>
<td>7</td>
</tr>
<tr>
<td>Named students</td>
<td>22</td>
<td>100</td>
<td>32</td>
</tr>
</tbody>
</table>

Table 2: Frequencies of protagonist-event combinations
It is interesting to note that 85% of the cases for which no event was given involved individual named students. In such cases, it was said that there had been a problem with Student N that was due to Cause a, without a problem event itself being stated. This rarely occurred for the entire class or groups of students, for whom a concrete event was remembered on each occasion. This finding was similar for both questions. There was, however, a difference between the questions with respect to the relation between subject matter insight and subject matter activities. It has already been pointed out above that the total number of subject matter insights was much lower for understanding problems than for progress. It is thus clear that in the few cases in which problems with subject matter insights were remembered, this always involved the entire class or groups of students, and not individual students.

The protagonist (or in this connection it is maybe more correct to talk about the "subject" of a problem) in a problem concerning insight was therefore not the individual student, but the entire class or groups of students.

In order to determine whether the tendency to name individual students was common to both questions, Spearman rank correlations were calculated for the numbers of students named. There was no significant correlation; i.e., teachers who, compared to their colleagues, tended to name relatively more individual students by problems in understanding, did not show the same behavior by progress and vice versa. In contrast, when the entire class was perceived as the protagonist, there was a significant correlation between the number of cases of progress and problems ($r = .47$ ($p < .05$)).

A closer look

The number of recalled student problems and progresses is surprisingly low. However, both detailed transcript analyses of some individual lessons (cf. Bromme & Steinbring, 1986) and field notes from all lessons indicate that a lot more than an average of 2 individual students per lesson and teacher had problems in understanding. However, these were hardly mentioned by the teachers in their reports. This leads to a first impression that only a few observations were important enough to be remembered by the teachers afterwards.

This is not to say that nothing at all was remembered. Instead, the teachers recalled the problems and progress of the class as a whole. By problems, this was indeed most marked.
Observations can be found by all teachers for the protagonist "the class", but there were eight teachers who did not name a single individual student as having a problem.

The structure of the reports also supports the view that the concrete observations were predominantly based on the class as protagonist. Thus, causes without events were more frequently introduced with the individual student as protagonist than with the class as protagonist (cf. Table 2). An interpretation for this is that answers about students were often the result of 'theorizing', but answers about 'the class' referred to observed events (cf. Calderhead 1984, p.58).

There were, of course, other namings of individual students, such as, for example, comments on stable features (e.g., immigrant students' language difficulties) or observations on individual students who were named as examples for global judgements. When naming individual students, some teachers gave only global judgements that were related to the engagement or performance.

It would seem that our study has produced a disappointing picture of teachers' memory for individual student's understanding that is similar to Shroyer's (1978). However, it also contains indications that something completely different was in the focus of recall (and as we infer, in the focus of teachers' awareness during instruction), namely the entire class and the instructional flow. This alters the impression of apparent blindness toward the learning process in the classroom. In the following, we will clearly point out what the teacher's attention was focused on in the classroom, using examples and quotations from the teachers' answers. We will have to dispense with a quantitative analysis, as the number of reports per teacher in which the class is the centre of recall was very low. A more interpretative description is necessary in order to account for the emphasis given to the class as a protagonist in teachers' interviews. This cannot be inferred merely from the frequencies of the categories.

There were always only one or two episodes in the lesson that contained problems and progress. However, these were the episodes in which a new step in the presentation of the curriculum took place. In this respect, they were key episodes from the teacher's perspective. This inference is also supported by the sequence of the recall of problems and progress. In most reports, the subject--related activities of the entire class were described first. Then, individual students were mentioned whose comments had indicated that the class had not yet understood something, or that articulated the insight that was desired for the entire class. The position of episodes in the course of the lesson was determined by the subject--related course of the lesson discussion, and not by the time of their occurrence.

Three teachers could even recall long verbal dialogues. One teacher began his account with a question from a student, and was then able to reconstruct the subsequent answers. He
commented, "This answer helped a great deal". The remembered situation occurred at the point where it was necessary to understand the new and really difficult task in the lesson. Sometimes only a single word was remembered: "Frank gave a key word at the beginning that indicated that he had made great progress". This answer illustrates how our question on the progress of individual students was often answered. Starting with such lesson episodes, comments were made on individual students that were oriented toward the subject content of the episode. Occasionally other students were also listed at this point. Memories of progress were more closely related to single situations featuring the contributions of individual students. In contrast, problems were not linked to the comments of individual students in this way. In such cases, the problem was described in subject-related terms, and was less frequently related to the utterances of individual students.

In the case of the questions on problems, descriptions were often given that were very exact in their reference to the subject content, but not in their reference to the protagonist or the time of their occurrence. For example: "The main difficulty in chance comparisons was that the students had to compare fractions." "The greatest difficulty was with the comparison of tables (on the results of dice throws)."

In summary, we can note that student contributions were remembered when they had a strategic value. By strategic value, we mean that they occurred at the moment when the lesson "had got stuck" (as one teacher expressed it) from the teacher's perspective, or where the actual transition from old to new knowledge was supposed to occur.

Both the pacing of teaching in classes of this age group and the methodological construction of the lessons permitted very few such transitions from old to new knowledge. Each class had only a few such "peaks". This also explains why all the teachers only reported between one and three episodes in which the class was the protagonist. The episodes may have occurred more frequently during the 45 minute lesson, but they were not arranged in memory according to the time of their occurrence, but according to content, and in this respect, only a few cases were concerned with problems in understanding and success.

Differences between teachers: Quality of teaching and professional experience

Observer ratings of the teachers' instructional quality were available from another part of the research project (Bromme & Dobslaw, 1986b). A factor analysis of these ratings produced two
relatively independent instructional quality factors. Factor I covered subject-related and student-related engagement, and Factor II described the degree of content-related and organizational structuring of the course of the lesson. The teachers' individual factor scores were correlated with the number of cases in which the different types of protagonist were named.

No correlation could be found for Factor I (engagement). Factor II correlated with the naming of the entire class as the protagonist in progress ($r = .40 \ (p < .05)$), but did not correlate with the recall for individual students in the classroom. The reverse held true for problems in understanding. There was a correlation of $r = .41 \ (p < .05)$ between the Factor II score ranking and the naming of individual students.

Therefore, when teachers actively structured their lessons, they remembered more progress in understanding by the entire class and more problems of individual students compared to colleagues who did not guide their class so firmly. However this does not mean that a more structured class is actually more effective. In the instructional quality study mentioned above, we found indications that a higher degree of structure was accompanied by a lower increase in learning for the particular subject of probability.

There was no relation between professional experience and the recall of classroom events that concern progress and problems in understanding.

After their fourth year, students in West Germany change to another school. Therefore 6th and 7th grade teachers have known their students longer than 5th grade teachers. So we tested whether there was a relation between this and the degree and extent of recall for students' progress and problems in understanding. However, Kruskal–Wallis one-way analyses of variance with grades 5, 6, and 7 as groups did not show any significant relation.

There was however a relation between a teacher's function as class teacher and the number of cases of individual students' problems in understanding. A Mann–Whitney U-test showed that class teachers named significantly more individual students with problems in understanding than teachers working with a class for which they were not the class teacher ($U = 15, p < 0.05$).
4. The teachers perceive the understanding of a 'collective' student

To summarize, it can be stated that the teachers remembered little about the progress and problems of their students. Consequently, these results would at first seem to confirm the rather pessimistic picture that has been presented by Shroyer (1981).

However, the teachers knew a great deal about students' problems and progress when they were of strategic importance for the instructional flow. It was often not important to know who had said what. It was only important to know what was said, what problems were present, and at what point the students' comments occurred during the subject-related course of the lesson. In other words, while the teachers did not know much about individual students, they had a fair recollection of the collective process of understanding within the instructional flow.

During classroom interactions, a notional 'collective student' was assembled from the many and varied contributions of individuals (2). All teachers showed good recall for the problems and difficulties of this 'collective student' but only about half of them did so for any of the individual students' problems.

In the following section, the results will be discussed within the framework of the demands that are placed on teachers in the classroom.

Students' understanding and learning in the classroom as a demand that is placed on the teacher

As we are interested in the perception and explanation of students' understanding as part of the teacher's task, we must investigate the nature of the tasks that teachers have to master. In doing this, we assume that the teachers' actions and perceptions are shaped by the tasks with which he or she is confronted in the classroom (Doyle, 1979, 1980; Bromme & Brophy, 1986).

The term task is more precisely defined in industrial psychology, but some conceptual differences may be applied to the work of teachers, and are useful for the interpretation of our data. In industrial psychology, a differentiation is made between the objective task content and its subjective reconstruction by the actor (Hackmann, 1969). The task content influences which actions are used to master the task. (The diagnosis of student mistakes, for example, demands
other actions than the diagnosis of illnesses.) Task content, however, only defines the space of action possibilities, as it can be interpreted and carried out differently. The task content is also dependent on the "nature" of persons, processes, or objects that have to be worked on in order to master the task. As a teacher's activity is an interaction between teacher and student that is communicated by the subject matter and the medium of the lesson, the "nature" of the task content is not constant. However, some aspects of the nature of the teacher's task can be described.

We assume here that one important aim of the classroom work of both teachers and students (though, of course, not the only one) consists in conveying or gaining knowledge and developing understanding. If one accepts this assumption, it becomes clear that the students’ own psychological processes of learning and understanding contribute to the task demand facing the teacher (Doyle, 1983).

Although the teaching process cannot be directly derived from the learning process, the processes and conditions of understanding largely determine the task demand that the teacher has to master.

We will now proceed to outline some recent findings from the psychology of the acquisition of knowledge.

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Students already have preconceptions of what a new concept could mean for at least the majority of subjects dealt with in the classroom. Thus learning and understanding does not mean the passive filling up of a container, but rather a restructuring of knowledge that is already present (Romberg & Carpenter, 1986; Davis, 1984). These findings from studies with students agree with the psychological pure research on understanding and retention which also points out the importance of existing knowledge structures for the understanding of new information (Rumelhart & Ortony, 1977). However, this finding leads to the "learning paradox": How can new knowledge arise through the application of old knowledge? This is not just a theoretical problem for researchers, but also represents a practical task for the teacher (Bereiter, 1985). In mathematics lessons, it occurs as a practical problem in the sense that the student is not aware that his or her old knowledge is mathematical knowledge; it is not organized according to the curriculum. The student has everyday concepts of 'number', 'equal', or 'probability' that the teacher is not able to simply exchange for the mathematical meaning of these concepts. Therefore teaching does not only require the imparting of mathematical skills and concepts, but also the conveying of a mathematical meta-knowledge. It is this that enables the student to understand the mathematical nature of concepts such as 'number', 'probability', etc.
The integration with old knowledge and the restructuring of old insights in the light of new information is not just a concern of psychology. It is also a consequence of the logical relationships of knowledge. To give an example: The meaning of the concept of irrational numbers is related to the concept of the rational number, which in turn, is related to the concept of the natural number. The meaning of the concept "number" alters according to the type of number under consideration. However, the meaning of the types of number that have already been understood also changes when one learns about new types of numbers.

Knowledge also has to be considered in such a way in other subject matter areas. In other words, the meaning of a concept depends on its relations with other concepts.

Thus, not only the psychological process of understanding but also the structure of knowledge imply that the understanding of new knowledge involves a restructuring of the old. This is why operations with knowledge are sometimes described with concepts of the content itself without recourse to psychological concepts about the operations.

Teachers may also possibly reflect on students' understanding in terms of subject matter content. Thus, one cannot only deduce that teachers reflect on understanding by studying their thoughts about the students, as their thoughts on understanding could also be hidden within considerations and perceptions of the subject matter of the lesson (3).

For example, ideas on an appropriate sequencing of mathematical topics (do we need to introduce fractions before dealing with probability) may be expressed by teachers as considerations about the 'logic' of the content, but are influenced by their experience with students' difficulties in understanding (as it is possible to introduce some elementary concepts of probability without presupposing a knowledge of fractions).

The understanding of subject matter requires activity, i.e. it is more easily achieved by self-contained working on tasks than by simply listening to instruction. This fact of knowledge acquisition has also altered the view of the role of the teacher. While in earlier research on teaching a direct effect of the teacher on learning was assumed or investigated, the role of the teacher is currently viewed differently (Hannischfeger & Wiley, 1977; Denham & Liebermann, 1980). The teacher only indirectly influences the student's learning, and can only directly influence activities in the classroom. By stimulating these activities, and directing the student to suitable tasks, he or she can provide learning opportunities, but neither learning nor understanding. Learning and understanding only occur as a result of the student's own activity, while the educational environment supports this process (Bereiter, 1985).
The previous basic findings on understanding render it plausible that when students have difficulties and make mistakes, they do not simply stop learning, but they construct their own, sometimes creative, and sometimes false solution strategies. This is particularly well proven in mathematics instruction, but is also true for other subjects (for mathematics, see Brousseau et al., 1986; biology, see Eaton et al., 1983).

Their own constructions of meaning sometimes enable the students to solve the required tasks even when they have not understood the subject matter in the way intended by the teacher or the curriculum. These independent constructions do not have to hinder understanding. They are simultaneously a prerequisite for the intended knowledge to be appropriately acquired. Students' subjective constructions and interpretations of lesson subject matter are not accidents. They do not only occur as students' errors, but rather their development in the mind of the student is a first step in the process of understanding. This is why incorrect answers from students are not per se obstructions to the course of the lesson, but constitute an essential object of the teacher's work.

These findings from cognitive psychology describe some of the demands that have to be mastered by teachers. It is necessary to bear them in mind if one wants to explain teachers' thoughts on their students' understanding. However, the process of knowledge acquisition in students only constrains but does not determine the teaching method. In other words, the way of teaching cannot be deduced from the process of learning.

Therefore we must ask which teaching method was prevalent in our study. Our data are concerned with lessons in which an open dialogue was carried out involving the entire class. This procedure was interrupted by phases of group and individual work. However, most of the time, the lesson followed the pattern of a 'questioning developing classroom discourse' (Voigt, 1985). This method of instruction is widely used and takes up most of the instruction time between the 5th and 10th grades in West German schools, as pointed out in studies by Hopf (1980) and Hage et al. (1985).

With this pattern of working on new knowledge, the teacher attempts to cultivate a student verbalization of the new knowledge through the use of suitable tasks and questions. Thus, the students do not just have to fulfill a learning role. To the extent that they participate, they take over — for themselves and the others in the class — a part of the presentation of the subject matter. This can develop so far that the teacher avoids explaining the new knowledge herself, and only regards a lesson as having been effective when at least some of the students have verbalized the new knowledge (Meyer, 1980) (4).
The participants' (students and teachers) contribution to the subject matter presentation is in the focus of recall.

The basic results on the nature of students' understanding and the teacher's instructional methods provide a sufficient description of the "nature" of the teacher's task to enable us to explain our findings.

The teachers remembered events from the phases of the lesson in which the new knowledge was introduced, and in which this introduction was prepared. No teacher reported observations on group work or the discussion of homework. It can be assumed that these peak phases also demand a great deal of attention from the teacher, and that he or she is then least able to rely on routines. In these phases, the knowledge that the students already possess must be reactivated, and at the same time, conceptual conflicts must be generated that can function as connection points for the new knowledge. The entire potential structure of knowledge of the unit in question has to be reestablished in order to introduce the new knowledge. We call this structure potential because it must – at least partially – be reactivated in the mind of the student. The introduction of the new knowledge then places further attention demands on the teacher.

In our study on the instruction of probability, a particular difficulty lay in coping with the relation between formalization and nonmathematical reality in probability. For example, for the students, this was the question whether chance can be subjected to calculation. Of course, such didactic problems vary within a subject and from subject to subject. The amount of attention they demand of a teacher is essentially dependent on experience with the subject matter and the position of the subject within the whole curriculum. Nevertheless, this example has been mentioned in order to illustrate that the teacher does not simply deliver the subject matter with an instructional procedure without having to think about it, but must concentrate part of his attention on the problems involved in its unfolding. Thus, not only the reactivation of the potential structure of old knowledge, but also the presentation of the new demand attention that cannot simultaneously be directed at the learning processes of individual students. Nevertheless, the presentation is aimed at the learning process of the individual student. Apart from this, the possibility of noticing individual students' problems depends on the teacher's familiarity with the students. (Class teachers named significantly more individual students than non-class-teachers.)
Some student comments were very precisely recalled as understanding progress, as they were part of the subject matter presentation. The progress of these students was recalled because it presented the intended understanding and served as a model for the other students.

Some student comments were very precisely recalled as problems in understanding, as they formulated the incorrect constructions of meaning and misunderstandings that were the object of the lesson discussion. The teacher needs an instructional presentation of these incorrect constructions in order to cope with the task of taking students’ preconceptions into account. It is ineffective and sometimes impossible for the teachers to anticipate all misunderstandings when planning their lessons. Therefore, by letting students explicate their understanding, the problems can be dealt with in the classroom. A teacher can take into account the students’ incorrect constructions of meaning without diagnosing them as individual students’ problems in understanding. Naturally, these problems were only a small proportion of the problems in understanding that actually occurred during the lesson. They were the problems of the ‘collective student’.

A second type of problem was also recalled: When incorrect answers were based on a lack of knowledge or misunderstandings that did not belong to the subject matter planned for the lesson, they were likewise recalled as problems in understanding. They endanger the course of further work on the new knowledge. This could be seen in our study by, for example, the calculation of fractions which is not, in itself, a part of probability, but is necessary for some of the tasks. Problems in understanding were then problems in the sense of the teacher’s difficulties in guiding the instructional flow. Thus, whether the students’ problems in understanding disturbed the instructional flow, or whether they were turned into the object of explanation and thus eliminated, depends on the flexibility and the breadth of the teacher’s professional knowledge. This is shown by case studies on the differences between individual lessons (e.g., Bromme & Steinbring, 1986).

5. Toward a model of teachers’ thinking about students and content:

Some theoretical implications

In this section we will sketch the consequences for models of teachers instructional activity. Such models have been formulated by, for example, Peterson & Clark (1978) and Shavelson & Stern (1981). These authors describe instructional activity as a succession of routines in which the teacher’s attention is directed at whether the students’ behavior remains within a framework of
specific limits. Conscious decisions only become necessary if the students' behavior crosses the threshold of tolerable deviations. "Student cues" are regarded as being decisive for the teacher's judgement of the actual state of the instructional flow.

Clark & Peterson (1986) have pointed out that in empirical studies on interactive decision making, student cues certainly provide more than one half of the triggers for conscious decisions. However, there are studies in which it becomes clear that, for example, the available time, the instructional material, or other factors influence the teacher's decision (cf. Shavelson, Atwood, & Borko, 1977). Finally, the teacher's behavior is not just a reaction to deviations that are already present, but it is also directed by the anticipation of possible and desired developments (Hofer, 1986).

Therefore, Clark & Peterson (1986) question this model, and propose that one should wait for further empirical findings before developing it further. In our opinion, a further empirical gathering of other possible cues that could likewise determine the action of teachers is not alone sufficient to solve the above mentioned dilemma in the model. It would be more fruitful to abandon the search for isolated cues that are differentiated according to the traditional concepts of psychological research (i.e., person vs. subject matter vs. instruction). The cognitive units of teachers in the classroom would appear to have other boundaries. Subject matter activities and insights are important units in teachers' thinking which cover both persons and context.

The boundaries of the teacher's cognitive units are not constant, but differ according to the work task for which they are required. Thus, one is more likely to find a cognitive unit "individual student" in a task in which students must be judged (e.g. marking), than in the shaping of the instructional flow.

Our study has also provided indications for a cognitive unit that is often overlooked; the entire class. Teachers apparently have pictures of the class that are not the sum of their impressions of individual students. It is not yet known when it is more the teachers' view of the class, or more their view of the individual student that influences their decisions. In any case, it must be realized that the interaction between the teacher and the class is not simply the sum of one-to-one interactions.

The theoretical dilemma, described by Clark and Peterson (1986), is also due to the concept of instructional flow. This flow metaphor has its strengths and its weaknesses. Its strength lies in the emphasis on the gestalt quality of the course of the lesson. The teacher perceives the course of the lesson as a whole and this provides the backdrop against which individual student comments are recalled.
The weak side of the metaphor lies in the fact that it does not capture the structuring effect of the teacher’s plans and knowledge about the lesson (or as Leinhardt, 1983, calls it, ‘agenda’). The course of the lesson appears as something constant that flows of its own momentum. However, in reality, teachers do not just watch over a flow, but generate it by presenting the students with subject-related goals and activities. Teachers and students have different roles in the classroom, even when the students retain much freedom in their contribution to the shaping of the course of the lesson.

The metaphor of instructional flow hides the fact that there are “peaks” in the lesson, to which the teacher’s attention is directed, and which are particularly important for the students’ progress in learning. In our study, the teachers particularly recalled the phases of working on new knowledge. Hoemberg (1982) has shown that mathematics teachers are especially good at recalling the length of phases in which they themselves were actively involved with the subject matter, while they were not so good at estimating the length of other phases. Lessons are not experienced as a steady flow of instruction, but as a succession of episodes of differing importance for the participants.

Students have different functions within the framework of the shaping of the lesson. They not only participate by individually understanding and acquiring knowledge, but also by presenting the subject matter and its possible interpretations. Thus, a model of instructional activity in which cues are identified that determine the action of the teacher must also take into account the different functions of students.

Students’ verbalized misunderstandings serve as a subject of instructional discussion about the students’ own construction of meaning. This has important consequences for models of teacher thinking. In the early days of research into teachers’ cognitive processes, the teacher was still regarded as a diagnostician, analogous to a medical doctor (N.I.E., 1975; Clark, 1986). However, when the students’ constructions of meaning are no longer deviations from actual learning processes, this becomes a false view. The problems in understanding must now much rather be understood as the material from which the teacher shapes the lesson, and on which the participants in the classroom work. This needs to be taken into account in both the formation of models and in the empirical investigation of teachers’ thinking.

In summary, it can be stated that the concept of instructional flow requires modification. It is necessary to allow for the different roles that the teachers and students occupy, and for the development of the subject matter within the instructional flow.
Additionally, teachers' cognitive units have been shown to be a key question. Our data suggest that it is not only the individual students, but also the reactivation of old knowledge and the development of new knowledge within the instructional flow that stand in the focus of the teacher's memory.

Footnote 1

Understanding is a precondition for the retention and transfer of knowledge. Although it is common practice in cognitive research to differentiate between the mastering of procedures and the understanding of concepts, etc., in most classroom learning, the development of understanding is also necessary for a mastering of procedures. Particularly when one considers that part of the mastering of procedures is to decide when they are suitable and when not, understanding then means being able to perform specific procedures, and knowing the conditions necessary for their application and their relationship to other knowledge. This is why we use the concept of 'understanding' in a very broad sense, covering the acquisition of knowledge in general.

Footnote 2

Of course, the collective student's contributions are a combination of the answers and questions of individual students, and therefore they may also contribute to the teacher's picture of the individual student. It must also be recognized that not all students participate to the same extent, and they also do not all receive the same amount of attention. Therefore, all students are not equally important for the forming of the 'collective student'. There are spatial zones of different teacher activity in relation to their students (Adams & Biddle, 1970). Lundgren (1972) has shown that the pacing of instruction is directed by the teacher's orientation toward a so-called steering group. He found that teachers oriented toward those students who lay between the 10th. and 25th. percentile of the ability distribution. In contrast to Lundgren, Treiber and Weinert (1986) found a tendency to orient toward the better students in a study of 5th. to 7th. grade teachers.

Footnote 3

Whether or not it is empirically the case that thoughts about students are hidden behind teachers' considerations that are given in terms of the subject matter content, is a subject for empirical investigation; for example, in other school subjects as well. In our study, we found it necessary to provide more categories of subject matter content in the analysis than has previously been the case. However, a cautionary note is necessary to avoid misunderstanding. We do not mean to imply that the 'logic of the subject matter' in actual fact always determines which pedagogic and methodological steps are best. Although the logic of the subject matter provides constraints on the choice of tasks and the selection of examples, applications, etc., there is no conclusive sequence of concepts or a priori decision on which concepts are better examples than others, which are easier to understand, etc.

This is why the tendency of some teachers to think about psychological processes of understanding in terms of the subject matter is actually a fact that can be empirically observed. How-
ever, this does not imply that the tendency to attribute the basis of all didactic decisions to the logic of the subject matter and to think exclusively in such subject-related terms is the only effective and didactically correct method (for probability in this context, see Steinbring, 1985).

The avoidance of misunderstanding is not the only reason for emphasizing this point. We are also concerned with mapping a direction for further research in our subject. The above described tendency appears to be related to the historical developments of meta-mathematical conceptions (Otto, 1979; Jahnke, 1986). Therefore it would be interesting to investigate the relation between teachers' views of mathematics and their views on students' understanding. Initial studies on the meta-mathematical perspectives of teachers are already available (see, e.g., Thompson, 1984). The relation between meta-conceptions of subject matter and the perception of instruction processes has also been investigated in other school subjects (Bawden, Buike, & Duffy, 1979).

Footnote 4

The pattern of a 'questioning-developing classroom discourse' can have various negative effects. One danger is that only a few good students, who are regarded by the teacher as being sufficiently competent, actually take part in this shared shaping of the lesson. Another danger is that the scope of possible answers is narrowed to the one answer which is expected by the teacher (Voigt, 1985). It can also lead to problems when the students can only guess from the teacher's questions what the lesson is actually about, instead of being clearly told what they have to do and what they have to learn (Brophy et al., 1983). These criticisms have been known for a long time. Nevertheless, the pattern is very widely used in schools. This makes us wonder whether there are not also positive effects that have contributed to the persistence of this pattern. One possible positive effect could be that the misunderstandings of students are best articulated by students themselves, and thus become an object of the classroom dialogue. Another possible effect could be that the contributions of good students describe the "zone of proximal development" for the other students.

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