

Methodological reflections on a three-step-design combining observation, stimulated recall and interview

Andreas Busse, Hamburg (Germany)

Rita Borromeo Ferri, Hamburg (Germany)

Abstract: In this paper a tripartite qualitative design combining observation, stimulated recall and interview is presented and discussed. This three-step-design makes it possible to get insight into the interaction of internal and external processes when solving mathematical tasks. The data analysis depends on the research question and the methodological approach. In the light of two research projects in mathematics education two different methods of data analysis are presented and methodologically reflected.

Kurzreferat: In diesem Artikel wird ein dreistufiges qualitatives Design bestehend aus Prozessbeobachtung, nachträglichem lauten Denken und Interview vorgestellt und diskutiert. Dieses Dreistufendesign ermöglicht ein Erfassen des Zusammenspiels interner und externer Prozesse beim Lösen von Mathematikaufgaben. Die Datenauswertung hängt von der Forschungsfrage und von der methodologischen Verortung ab. Am Beispiel zweier mathematikdidaktischer Forschungsprojekte werden zwei verschiedene Auswertungsmethoden vorgestellt und methodologisch reflektiert.

ZDM-Classification: D20

1. Introduction

It is of major interest in mathematics education to understand the connection between internal and external processes that occur while working on the tasks in their interdependence. While external processes are directly observable the attempt to understand internal processes produces difficulties, as they cannot be directly accessed. In this article different methods will be discussed in order to later present a three-step-design. Finally, the problems which occur during the evaluation of the collected data will be addressed. The examples that will be mentioned refer to two research projects from Hamburg, one of which is a study on the role of context in realistic tasks (Busse & Kaiser 2003), the second of which is a study on mathematical styles (Borromeo Ferri 2003 and Borromeo Ferri & Kaiser 2003). In the context-study it is explored how 17-years-old students deal with the context of realistic tasks. This is done by reconstructing the students' contextual ideas that arise during the work on the task. The study aims at finding patterns of dealing with the context. The study on mathematical thinking styles discusses whether learners' different mathematical thinking styles (analytic, visual, conceptual) can be reconstructed in grade 9 and 10 and how they manifest themselves. Here the focus is mainly on the connection between internal imaginations and external representations the students use during problem-solving.

2. Towards the three-step-design

In this section problems of getting insight into internal processes will be discussed and a three-step-design will be proposed as an answer.

2.1 Getting insight into internal processes

Our above mentioned studies were preceded by smaller methodical pre-studies in order to test adequate methods to get insight into internal processes. Two different approaches can be distinguished: gaining data *after* working on the task and gaining data *while* working on the task.

After working on the task: In our pre-studies on the one hand we asked students to write freely stories about the task they had just worked on, on the other hand we conducted interviews. Although the data we got by these methods provided us interesting insights what was in the students' minds concerning the work on the task, the immediate connection to the process of working on the task was, due to the time-distance, not always given. In addition to that it could not reliably be reconstructed, which thoughts were already present *while* working on the task and which thoughts were created *later*, while writing the story or while giving answers in the interview. Furthermore, in the interviews the test subjects uttered more general aspects concerning their attitudes towards mathematics in general or classroom-mathematics respectively. Hence these data were only of very limited use for getting insight into the internal processes during the work on the task.

While working on the task: In our pre-studies we used the methodical approach of thinking aloud simultaneously (Weidle & Wagner 1994, p. 99f). Furthermore we let the test-subjects simultaneously make notes about certain aspects of their internal processes while working on the task. The result of these attempts was that the test subjects were severely distracted from their work on the task (cf. Weidle & Wagner 1994, p. 99f). The phenomenon could especially be observed at less able students. In the above mentioned context study (Busse & Kaiser 2003) where the test subjects were asked to utter contextual aspects of their thoughts an additional distraction could be observed caused by the permanent change of levels from mathematical aspects to contextual aspects and the other way round. Therefore getting data by simultaneous approaches turned out to be interferential in a way that the processes which were to be observed were severely disturbed by the methodical approach.

2.2 Stimulated recall

A way of being close to the process of working on the task without interfering the process itself is the method of *stimulated recall*. This methodical approach was developed by Wagner et al. (1977) referring to methods of cognitive psychology dated in the first half of the last century (cf. the synopsis in Weidle & Wagner 1994). When applying the method of stimulated recall the test-subject is shown videorecords of his or her work on a task, of a classroom activity etc. immediately after the recording. The playback is interrupted at certain moments in order to give the test-subject an opportunity to utter something about the just seen sequence. The playback serves the test-subject as a help to recall what was in his

or her mind at the moment of the action seen in the playback. So on one hand the immediate connection to the work on the task (or the classroom activity etc.) is given, on the other hand the process itself is not interfered by verbalisations.

The kind of instruction the test-subject is given for the stimulated recall depends on the research question. In studies on classroom-activities (Weidle & Wagner 1994; Knauth, Leutner-Ramme & Weiße 2000) the students were asked to utter *everything* that (according to their recollection) went through their mind in the situation shown in the playback. The research question of the above mentioned context-study causes a more restrictive instruction: only thoughts concerning the *context* of the task are permitted. In the above mentioned study on mathematical thinking styles the test subjects are encouraged to utter their first ideas and impressions, their problems within the solving process and, first and foremost, their imaginations (e.g. whether they had a picture in their mind or rather formulae). In any case it is essential that the test subjects utter only those thoughts that were already present in the action *itself* which has been videotaped, i.e. thoughts created when watching the playback are not permitted to voice. Additional reflections and associations when watching the playback must be avoided in order to keep the immediate connection to the action itself.¹

It is another methodical decision *who* is to interrupt the playback: the researcher or the test subject. Weidle & Wagner (1994) propose that the researcher interrupts the playback each time a unit of meaning ends. In our studies we decided that mainly the test subject herself or himself stops the playback whenever he or she wants to utter something according to the instructions given. Only if the researcher assumes the situation shown in the playback is interesting in respect to the research question and the test subject does not interrupt the playback the researcher is allowed to do so. It can be expected that young test subjects might be shy to stop the playback on their own in order to utter something. Heymann (1982) follows the same line, in his study both, the test subject and the researcher are permitted to interrupt the playback.

Furthermore it has to be decided which role the researcher plays during the stimulated recall: Does he or she remain silent in order not to disturb the test subject's concentration on the past (like in the context-study)? Or does he or she enquire from time to time in order to gain a broader data base (like in the study on mathematical thinking-styles)? It is also conceivable to conduct a semi-structured interview in the stimulated recall phase. (Stillman 2000)

It remains to be decided in which social constellation the process which is videotaped is to take place. It is e.g. possible to record whole school classes during their classroom activities (Weidle & Wagner 1994; Knauth, Leutner-Ramme & Weiße 2000). Another possibility is to videotape individual work on tasks. Among other aspects it is the research question that is the decisive factor: What

role does interaction play in the study? In our studies we decided to let the test subjects work in pairs following Schoenfeld (1985). Schoenfeld (1985, p. 177) points out that "For a variety of reasons, two-person protocols provide the richest data for the purpose described. Oddly enough, single-person protocols can generate very consistent but thoroughly unnatural behavior." Other reasons for pair protocols are given by Goos (1994, p. 145): "Pair protocols are more likely to capture a complete record of students' typical thinking than single protocols because, first, two students working together produce more verbalisation than one and, second, the reassurance of mutual ignorance can alleviate some of the pressure of working under observation."

There are more occasions to utter something during the stimulated recall phase if the work on the task has taken place in the more communicative way of work in pairs. In addition to that working in pairs is a teaching method that is usual at least in German classrooms. Hence the research situation is not very far from a familiar classroom situation. In this case interaction even if it is not the focus of a study must be taken into consideration when analysing the data.

2.3 Embedding the stimulated recall in a three-step-design

After working on tasks (respectively after lessons) and after the stimulated recall it is suggested in literature (e.g. Weidle & Wagner 1994) to add an interview as a third step. The use of the interview is closely connected with the way the phase of the stimulated recall is structured. If the researcher does not make any inquiries during the stimulated recall the interview offers an opportunity for detailed inquiries. Accordingly, the context-study, where during the stimulated recall hardly any inquiries were made, used the interview to get more information on the personal background of the test-subjects' statements. The study on mathematical thinking styles, during which inquiries were already made during the stimulated recall, used the interview to ask more in-depth questions concerning the attitude, the perception of mathematics etc.²

tab. 1: overview of the three-step-design

I	II	III
problem solving process	stimulated recall	interview
pairs are solving problem (video-taped)	individual statements on the problem solving process as seen on video (audio-taped)	individual interview with in-depth questions about the two other phases (audio-taped)

² In our studies an unintended effect of the interview occurred: While the stimulated recall was perceived to be very exhausting because of having to concentrate strongly and the struggle to remember, the interview seemed to be relieving as it offered the opportunity to comment on topics which had been suppressed by the limiting instructions in the stimulated recall.

¹ Hence Weidle & Wagner (1994, p. 84) propose to let the test subjects exercise the method as a run-up to the study in order to learn which kind of utterances are permitted and which not.

One has also to consider in what kind of social context the phases of the stimulated recall and the interview took place. In our investigations we decided to divide the couple which worked on the tasks. Consequently, the stimulated recall and the interview took place with only one test-subject and the researcher. This is due to our research interest which mainly focuses on individual aspects. Consequently, the three-step-design consists of problem solving process, the stimulated recall and the interview (tab. 1).

3. Evaluation of the data

The presented three-step-design offers a data record consisting of three types of data each of own quality for every data sample and test-subject. These data can be structured in two ways: horizontally and vertically. Whether the data are structured and evaluated horizontally or vertically depends on basic methodological considerations and especially on the underlying research question.

3.1 Horizontal structure

The data gathering is shaped by the strong connection between the three types of data, in which data type I is the framework of the general data in the horizontal structure. Ideally, when going through the data of type I chronologically the data of type II can be assigned to testpassages of type-I-data, which is mainly possible when the videotape is stopped. The same can be done with single passages of the interview which can be assigned to single remarks from the stimulated recall or the problem solving process. However, the linkage is not always possible or unambiguous for all parts of the interview. This is on the one hand due to in what way the questions and answers of the interview are connected with the stimulated recall or the problem solving process and on the other hand general interview statements which are less interesting for the researched phenomenon can only be assigned in very

time. A statement, for example, which was made at the end of an interview complements the respective passage of the text at the beginning of the stimulated recall and the problem solving process. In that case statements can be linked back horizontally.

The statements of the three data types can mainly be structured in tabular form as shown in figure 1, so that statements referring to the same phenomenon can be analysed and compared horizontally.

3.1.1 Codified analysing process - irrelevance of sequentiality

Due to the horizontal course of action it is impossible to use a sequential analysing process which takes into account the chronology. The question whether or not to use the sequential analysis depends on the research question. In the study on mathematical thinking styles (Borromeo Ferri 2003 and Borromeo Ferri & Kaiser 2003) the mathematical thinking styles are rooted intrapersonally. Therefore, the placing in the text is irrelevant for the phenomenon. It is of greater interest *how* the phenomenon manifests itself in the problem solving process, in the stimulated recall and finally in the interview. To get as many learners' reflections as possible the frame of permissible utterances in the stimulated recall on thoughts in the problem solving process was not narrowly defined. Moreover, the researcher stopped the videotape in order to make specific inquiries. In addition to the focused questions in the interview more inquiries were made by the researcher. Thus, the phenomenon can appear in three different types of text. They are inevitably intertwined in the horizontal analysis and therefore constitute a complementary process. Therefore, the sequentiality does not play an important role for the object of research.

The *Grounded Theory* approach (Strauss & Corbin 1990) -which is also known as the so-called codified process- underlies the study on mathematical thinking styles and can be used as a methodological basis for the horizontal analysis. Within the methodological approach the encoding of the data is a central element of an object-based development of theory. Through this the comparison of categories and the assignment of single text segments to new categories are of fundamental significance.

The following example from the study on mathematic thinking styles shows using the example of test-subject Vera the horizontal way of proceeding in connection with the codified process according to the Grounded Theory approach to explain an analysis which refers to the phenomenon.

For this study a code system was developed from which a code is taken for the example.

Starting with data type I the transcript is read until a relevant phenomenon appears which has to be assigned to an already existing code or which has to be encoded. Vera's statements (written in italics), made during the work on the tasks together with her partner, are seen as a relevant single phenomenon and are encoded. For example, she mentioned that she likes to make a drawing for solving tasks. After this statement the videotape was stopped and the test-subject was asked to do the stimulated recall, as the researcher was interested to see her

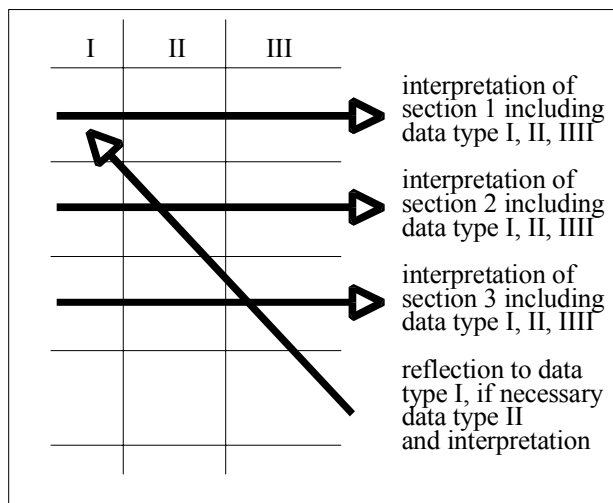


fig. 1: diagram of horizontal structure of data interpretation

few cases. In the course of the different types of data it can be the case that some relevant statements appear and can be assigned to the respective text passages at a later

following thoughts.

Thus, instead of following data type I in the analysing process the data type is changed into type II in order to see whether the statement in the stimulated recall supplements the phenomenon observed during the problem

information and leads therefore to a comprehensive analysis. The strength of the horizontal analysis lies in its comprehensive opportunity to interpret external and internal processes as well as general backgrounds and attitudes which can all be linked (fig 2).

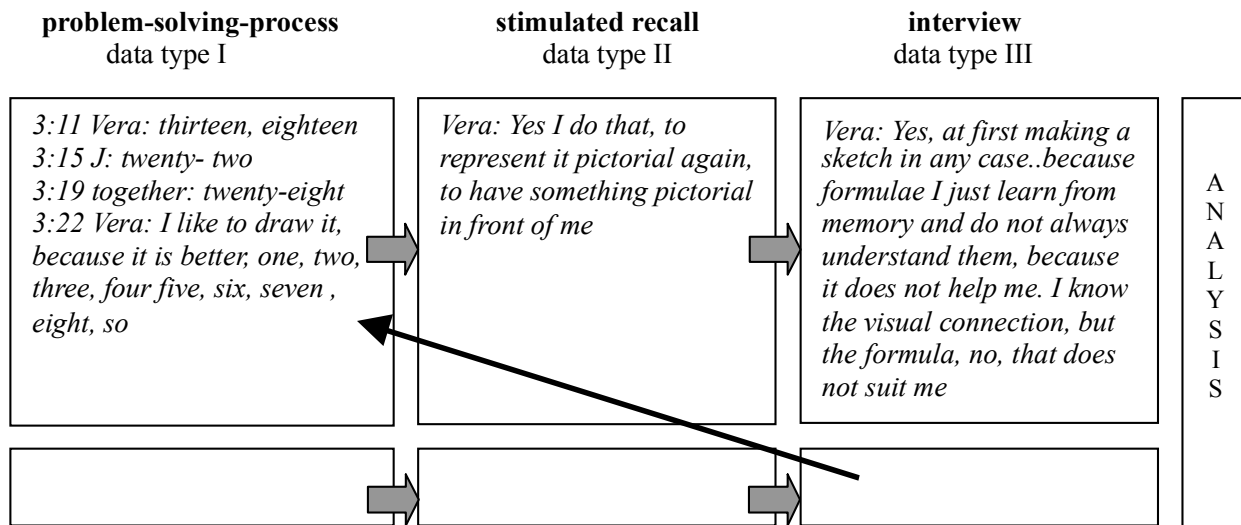


fig. 2: example of a horizontal analysis

solving process. Vera’s statements prove to be very stimulating for further insights as she mentioned that she finds drawings helpful and that figurative presentations of facts help her to imagine tasks more easily. This extra information might not have been mentioned as extensively without the stimulated recall but contributes as another single phenomenon to the comprehensive analysis. It is assigned to the same code as the text section from data type I and therefore supports the assumption that Vera has preferences for visual imaginations and visual representations.

After that one changes to data type III, the interview, and searches for text sections in chronological order which supplement those from the work on the task and the stimulated recall. Vera’s statements appear to be very important regarding the examined phenomenon. She became even more concrete as she clarified that she always needs to draw a sketch, as she understands mathematic facts more easily through sketches than through calculations and formulae. Especially the last statement confirms the assumption of the preceding text sections and reaffirms the researcher in his comprehensive analysis of the three text sections particularly regarding the hypothesis that Vera has extensive preferences for the visual thinking style. This assumption is also supported by further text passages within the horizontal analysis.³

Concluding, the single phenomena can be examined by the horizontal analysis in all three text types, as the example has shown. From the process of working on the task via the stimulated recall to the interview a kind of supplementing process occurs, as every text type contains

3.2 Vertical structure

By using a vertical structure when interpreting the data each of the data types I, II and III is considered as a unit and is interpreted separately (fig. 3).

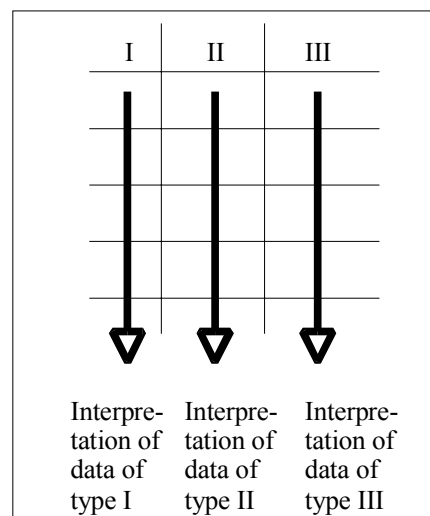


fig. 3: diagram of vertical structure of data interpretation

This kind of looking at the data is adequate if the three methodical approaches of the three-step-design can be clearly separated from each other. This is the case in the above mentioned context study (Busse & Kaiser 2003): The step of working on the task shows (under the best of circumstances) no intervention by the researcher. During the stimulated-recall-phase the test-subjects utter those thoughts that have taken place during the work on the task. There are strong restrictions, which utterances are permitted: Only those thoughts are allowed that have already been present during the work on the task, and the

³ The process of encoding in this study was supported by the software ATLAS.ti in order to on the one hand manage the enormous amount of data and on the other hand to compare the allocated codes and subcodes more systematically.

thoughts must have a connection to the context of the task. The test subject must not reflect on his or her thoughts, and the researcher is not allowed to enquire to get deeper information. It is in the nature of an interview (step III), that the researcher's role is more prominent than in the two previous steps. Here the researcher is allowed to ask deeper going questions concerning the test-subject's reflections and embeddings in his or her personal experiences. The strict methodical separation is caused by the research question, in which the two levels "mathematical work on the task" and "context" must be clearly distinguished.

Following Denzin (1978) this is called *method triangulation*. (Flick 2000b, p. 310) The necessity of separating the data in the mentioned way is led by the idea, that the object of research (and consequently the potential of insight) is constituted by the methodical approach.⁴ (Schründer-Lenzen 1997, p. 108; Flick 1995b, p. 432; Flick 2000b, p. 310) Consequently the various interpretations gained by the the approach of data separation must not be added in the sense of a puzzle of information to get a comprehensive picture. (Silverman 1985, p. 157) "What goes on in one setting is not a simple corrective to what happens elsewhere – each must be understood in its own terms." (Silverman 1985, S. 21)

Therefore the three vertical interpretations cannot mainly be seen as a validation of each other, because the data are gained under different conditions. The idea of method triangulation as a means of validation is not far spread in recent literature on methodology any more. (Flick 2000b, p. 311) Method triangulation is to deepen and broaden knowledge and not to describe an "objective" truth, because – following the idea that the object of research is constituted by the methodical approach – an objective truth cannot be assumed. (Fielding & Fielding 1987, p. 33; Flick 2000a, p. 251) Each of the three approaches of the three-step-design has consequently the same legitimation, none of them is central. (Flick 2000b, p. 314)

The aim of method triangulation

"should be less to achieve convergences in the sense of a confirmation of aspects already found. The triangulation of methods and perspectives is instructive especially when *divergent perspectives* can be clarified, (...). In this case a new perspective emerges that requires theoretical explanations." (Flick 2000b, p. 318, emphasis in original, translation by the authors.)

"sollte weniger sein, Konvergenzen im Sinne einer Bestätigung des bereits Gefundenen zu erhalten. Aufschlussreich für die Theorieentwicklung wird die Triangulation von Methoden und Perspektiven vor allem, wenn sie *divergente Perspektiven* verdeutlichen kann, (...). Dann ergibt sich eine neue Perspektive, die nach theoretischen Erklärungen verlangt." (Flick 2000b, p. 318, emphasis in original)

Later in the text an example will be given to illustrate this aspect.

3.2.1 Characterisation of the data types

Referring to the data analysis of the context-study characteristic features and questions can be formulated for

each of the three data types:

The data of type I can be characterised (among other things) by the facts that they are gained by an observation with little interference by the researcher, that they are directly linked to the work on the task and that is the interaction with the partner which produces the data. Possible questions on the data on this step are: How do the test subjects deal with the context while working on the task? Which role does the interaction between the partners play? Do contextual ideas change during the course of the work on the task? Where and when do contextual ideas appear while working on the task?

The data of type II stem from a situation close to an interview (stimulated recall) without questions being explicated by the researcher. The link to the work on the task is no longer a direct one, just as the interaction between the partners happens in an indirect way via the videorecord. Possible questions are e.g.: Are there any hints that a test subject has had some thoughts about the contexts which have not been voiced during the work on the task? Are there any private thoughts which do – according to the test subject – not belong in the public and official situation of the work on the task but do belong to the stimulated-recall-phase? Are there any hints on the depth of possible contextual ideas? Are the strong restrictions of the stimulated recall kept? By which utterances are they possibly left?

The data of type III belong to a classical interview, in which the researcher asks and the test subject answers. There is no more interaction with the partner, the researcher is more prominent. The distance to the work on the tasks is larger than in the data of the other two types. Possible questions are e.g.: What does the test subject voice in the relatively open (compared with the stimulated recall) interview situation? How does the test subject embed his or her former utterances in his or her personal background of experience? How does the subject give meaning to his or her former statements? Are there any hints that the test subject will deal with the context of a task in future in an different way?

The above mentioned questions do not have to be answered necessarily by data of a type they are linked to but there the chance of getting answers is considered to be higher than from data of other types. Not all questions can be answered from each data set.

3.2.2 Analysis of vertically structured data

The context-study is methodologically based on qualitative interpretative research in mathematics education as it is discussed in the German speaking scientific community. (Jungwirth 2003) In the following it is stated how the interpretative approach can be realised within the frame of the three-step-design and which problems arise. The touched topics will be sequentiality, interaction, quantity of data, and case characterization.

When analysing the data of the context-study it is adequate to take the *sequentiality* (Flick 2000a, p. 235) into consideration in order to grasp methodically possible developments of contextual ideas. (cf. Jungwirth 2003, p. 195) The vertical structure of data analysis corresponds well with taking the sequentiality into account. In context of the approach of the *Objektive Hermeneutik* where a

⁴ This idea is not elaborated by Denzin (1978). By him method triangulation is mainly seen as a means of validation.

strict sequentiality plays a special role it is important

"...that no retrospective anticipations may be considered: The researcher must not include information that appears later in the course of the case in order to clear uncertainties, ambiguities etc. of the present passage, because the acting persons do not have these information either at this stage." (Flick 1995a, p. 164, translation by the authors)⁵

"... dass zur Interpretation einer Textstelle keine retrospektiven Vorgriffe herangezogen werden: Der Forscher darf keine Kenntnisse aus im zeitlichen Verlauf des Falles (...) später abgelaufenen Prozessen ableiten, um Unsicherheiten, Mehrdeutigkeiten etc. der aktuellen Textstelle zu klären, da die Handelnden über diese Kenntnisse im Verlauf auch noch nicht verfügen." (Flick 1995a, p. 164)⁵

It could be argued that data of type II may be used when analysing data of type I because the instruction for the stimulated-recall-phase (data of type II) states that only those thoughts may be uttered that were already in the test subject's mind when working on the task (data of type I). There are two reasons why this assumption is too strong: First our experiences show that test subjects do not always follow the instruction strictly. Sometimes statements are made during the stimulated-recall-phase that have a summarising or reflecting character and sometimes an utterance in the stimulated-recall-phase refers to a later passage of the working process. Hence one cannot be sure whether or not an utterance stated in the stimulated-recall-phase refers to an unspoken thought of the present passage of the data of type I. Second the utterances made in the stimulated-recall-phase may refer to non-verbal aspects of thoughts (like emotions or internal pictures). In this case these non-verbal aspect are verbalised *for the first time* during the stimulated-recall-phase, e.g. the text is not created until then. The test subject has not had this thought in a verbal way when working on the task. A consideration of this verbalised thought of data type II when analysing data of type I would contradict the rule of sequentiality. (cf. Weidle & Wagner 1994, p. 85)

When applying the three-step-design a large *quantity of data* is piled up. With reference to the research question not all passages of the transcripts are equally relevant, if e.g. the test subjects need several minutes to calculate something or if they talk about something to relax for some seconds. In order to analyse the data in a detailed way (partly by a turn-by-turn-analysis) it is necessary to concentrate on relevant passages. Those passages which are not be analysed in detail are interpreted merely extensively. By that on the one hand the sequentiality of the text is preserved, on the other hand long transcripts can be handled. (cf. Schneider 1994, p. 160)

Another problem is caused by the methodical dodge of using pair-interviews⁶ that brings in the aspect of *interaction* which is not a focus of this research. The focus of the context-study is rather the revelation of patterns how students deal with context of realistic tasks. Interaction is

merely a means to an end. These patterns are not seen as unchangable characteristics of a person but they are considered as temporarily-situatively linked to the person. (cf. the comment on "Stabilitätsorientierung" in Jungwirth 2003, p. 190). In practice of this research interaction is dealt with as follows: When analysing the data of type I (work on the task) only the utterances of one test subjects are interpreted in detail while those of the other test subject are paraphrased. It is useful to pay attention to these paraphrases in order to understand the statements of the first test subject in the process of interaction. So a comprehensive analysis of the data of the first test subject can be achieved. Afterwards the statements of the second test subject are treated in the same way. It is important to note that in this second analysis of the data the paraphrases of the first test subject probably are of a higher quality because the utterances of the first person have already been analysed in detail. Hence the second test subject's paraphrases from the first analysis are gone over again on the background on the detailed analysis which has now been taken place. By this way of analysing the data it is ensured that the interactive character of the data is considered without too much focussing on the processes of interaction.

As interim findings of the context study case characterisations are formulated. A case in this study includes a test subject's data of one task. Hence the three-step-design applied on one given task solved by a pair of test subjects leads to two data-sets, each containing data of three types. Three possibilities can be distinguished when formulating the case characterisations. This distinction is based on the approach of method triangulation. All possibilities are found in the data analysis.

Possibility 1: Different partial analysis emerge from data of different types. They do not refer to each other, in particular they do not contradict each other. Then the partial analysis are additively brought together (partly under consideration of the type-specific conditions of their origin).

Possibility 2: A common core emerges from from data of different types. Here a mutual (i.e. no data type is more important than another) validation can be assumed.

Possibility 3: Analysis of data of different types refer to similar aspects and cannot be brought together because they seem to contradict each other. Here a consideration of the different features (i.e. the different origin of data of different types) comes into fruition. By taking the different features into consideration it is tried to find a theoretical explanation that resolves the seeming contradiction. This possibility is to be illustrated by an small example taken from the context study: The analysis of Christine's type-I-data shows that she utters hardly anything that can be linked to contextual ideas. On the other hand her type-II-data show, that Christine has a varied world of contextual ideas which goes far beyond the task itself. The seeming contradiction can be explained as follows: According to Christine's view contextual ideas are out of place during the official and public work on the task. Although she does have contextual ideas she considers them as her private affair. Hence this seeming contradiction does not lead to the conclusion that one of the partial analysis is unusable but taking the features of the data

⁵ On the other hand it would be allowed to consider information gained from data of type I when interpreting data of type II because the latter are created later. This can be formulated analogously for data of type III.

⁶ Pair interviews are chosen to provoke utterances.

types into consideration a new analysis on a higher level emerges.

4. Methodological remarks and reflections on the three-step-design

In the following some methodological remarks as well as reflections on the three-step-design are presented, some of which are mentioned in the literature but are also based on our experiences. The following aspects are not meant as arguments against the three-step-design as such but are supposed to be understood as critical reflections which will be taken into consideration during the application and later in the evaluation.

As in all examinations, the test-subjects' statements are their own interpretation of the scene of events. This means, regarding our methodological approach that during the stimulated recall as well as during the interview it is not reality that is dealt with but only the interpretation of a part about which the test-subjects is able and willing to speak. Thus, it can be assumed that more things were considered while working on the task than are later expressed. This is on the one hand due to the fact that while working on the task thoughts, pictures and emotions can appear simultaneously which cannot all be expressed at the same time. On the other hand not everything which has influenced the act in the working situation can be consciously accessed (cf. Weidle & Wagner 1994, p. 84f).

The social situation during the stimulated recall and the interview where the researcher plays – in contrast to the problem solving process – a major role in the interaction, can provoke statements that the test-subject considers to be socially accepted. This risk is even higher during the stimulated recall if the videotape was stopped by the researcher and not by the test-subject.

During the analysis of the data we repeatedly were confronted with the phenomenon that test-subjects made statements during the stimulated recall which did not suit the scene which had just been seen on video. It seems that in these instances the test-subjects remembered the assignments incorrectly. This was revealed when the earlier statement was corrected later during the stimulated recall or when the statement made during the stimulated recall definitely referred to a later part in the problem solving process. This is an indication that also other statements of the stimulated recall possibly refer to parts of the work where the test-subject did not think of them.

Some test-subjects deviated from the instructions during the stimulated recall and explained for example their course of action in a technical manner or made statements on the social situation they were in while working on the tasks. While the former might be due to a misunderstanding of the instructions, the latter might be indicating that the test-subject regarded the statement as so important that he or she made them despite contrary instructions. The deviation from the instruction becomes more evident when the latter is narrowly defined.

5. Final remarks

The three-step-design offers an adequate possibility to include the connection between internal and external processes. By the sequence of problem-solving process,

stimulated recall and finally an interview, various methods are in connection with each other. The three-step-design as a possible method for reconstructing cognitive processes does not determine *how* the data are to be analysed. It got clear that primarily the research question and methodological decisions are important for analysing the data.

Furthermore, the three methodical approaches of the three-step-design do *not* aim *independently* at the object of research: the type-II-data refer to the type-I-data and the type-III-data refer to the data of the other two types. The role of this dependency on the background of the concept of method triangulation remains an open methodological question for the time being. Here future research has to be done.

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Authors

- Busse, Andreas, Ida Ehre comprehensive school,
Bogenstraße 34-36, D-20144 Hamburg (Germany)
E-mail: Busse@uni-hamburg.de
- Borromeo Ferri, Rita, University of Hamburg, Department of
Education, Institute 9, Von-Melle-Park 8, D-20146 Hamburg
E-mail: Borromeo@erzwiss.uni-hamburg.de