

FROM “TEACHER RESEARCHERS” TO “STUDENT TEACHER RESEARCHERS” – DIAGNOSTICALLY ENRICHED DIDACTICS

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Being in the “age of adulthood”, our professional responsibility also requires that we focus our attention and efforts more closely on the dichotomy between classroom teachers and researchers. This seems to be of crucial importance since numerous studies report that teachers often view research as having little relevance to their practice or specific classrooms. Therefore, inservice activities designed by educational researchers based on (their) research results frequently fail to “achieve a meeting of minds” as Alan Bell has phrased it in his previous paper. Furthermore, looking at the historical issues of “teachers as researchers” Dawn Brown (1997) stresses the fact that classroom research has traditionally been viewed as the domain of researchers and university lecturers and NOT as that of classroom teachers. Despite the acknowledgeable efforts of individuals, I think this view is still shared on both sides by many teachers and researchers.

I do not want to deny the importance of research from an “external” perspective, i.e. with respect to the psychological aspects of learning environments in school mathematics that Jorge Falcão has outlined and which clearly require the expertise of psychologists in order to document and analyse respective phenomena. On the other hand, teacher inquiry does not only foster the development of their own professional skills but can offer insights, i.e. on patterns of student interaction, while constructing mathematical meaning, based on long-term data that is hardly accessible by temporary visitors to the classroom, or even during clinical interviews. Therefore, their findings inform mathematics education research and curriculum development.

In the following I will argue as to why I think that teachers as researchers and especially student teachers as researchers should be given more attention with respect to teacher education in the future. But before I elaborate on this notion and our experiences with this approach, I briefly want to “look back” and highlight the achievements and contributions of PME members that inspired and guided the work with student teachers.

Teachers as researchers: The work of PME members

During the past 25 years an increasing number of single research reports, short orals and posters focussing on the challenges faced and insights gained by teachers` research but also on its constraints have been presented and discussed and this panel presentation does not allow me to report all of them or even a selection. However, this work is well documented in the PME proceedings and therefore accessible to everybody interested in this facet of mathematics education research and development. Instead, for my “look back” at previous PME work I want to refer to the treatment of this topic over a period of time in a collaborative setting.

Between 1988 and 1996 a group of PME members continuously worked *on* and *in* the context of teachers as researchers. A discussion group initiated by Stephen Lerman and Rosalinde Scott-Hodgetts transformed into a working group in 1990 as interest grew and membership stabilised. Over the years, the participants of the working group explored the dialectical relationship between teaching and classroom research in the belief that mathematics teachers can and should carry out research in their classrooms. In 1997 their work resulted in the publication of a book titled „Developing practice: Teachers’ inquiry and educational change“ which was edited by Vicky Zack, Judy Mousley and Chris Breen. The 18 chapters of the various authors working in different cultural settings document quite clearly that the teacher as researcher approach has led to an impetus and encouragement for teachers to actively participate in educational inquiry, its increasing integration in inservice training programs, and the need for collaboration among teacher-researchers themselves and with university-based-researchers and administrators. These trends with respect to mathematics teacher professional development are also reflected in two other publications that have resulted from PME working groups focussing on teacher professional development in the last decade – however these books do not primarily focus on teacher-researchers:

- “Mathematics teacher education. Critical international perspectives” (Jaworski, Wood & Dawson 1999)
- “Working towards a common goal: Collaborative paths in mathematics teacher education” (Peter-Koop, Begg, Breen & Santos-Wagner, forthcoming)

In addition, the chapters in a book on teachers’ inquiry (Zack et al.1997) highlight a number of important questions and desires which characterise and determine teacher research and which are also relevant for the notion of student teacher research.

The difference between teacher research and teacher experience

A frequently raised question is concerned with the difference between teacher research and experience, since (most) teachers carefully plan units and individual lessons, implement these plans, observe and reflect on results and consequently adapt their preparations and actions accordingly. In this context, Mousley (1997, 2) understands research in a similar way to algebraic expressions which have been generalised from particular situations:

I believe that research transcends the limitations of experience, in that what is learned from experience is abstracted and articulated to the extent that it can be applied in new areas (i.e. elsewhere in time or place or content etc.) ... Teacher inquiry also transcends experience in that it involves more than making space in our lives for alternative practices: it entails the construction of a new level of thought.

Reflection seems to play a crucial part in the research process which clearly differs from reflective processes involved in experience. Kemnis (1985) stresses the political dimension of reflection in teacher research, pointing out that it goes beyond inward

looking and arguing that it has meaning in relation to historically embedded contexts – thus it stimulates social change as well as personal change. Another difference between individual experience and research is concerned with the need for reporting the design, methodological approaches and outcomes of research. Student teachers who under the supervision of an university researcher engage in classroom research as part of their initial teacher training program, at the same time learn how to reflect and report their findings in an academic manner.

The chapters by Eileen Philipps and Vicki Zack clearly demonstrate the benefits of teacher inquiry for the teacher professionalisation process. Phillipps (1997, 16) in this context uses the metaphor “to make the transition from searching to researching” while Zack (1997, 181) characterises researching from the inside as “generative and transformative”. With respect to introducing student-teachers to classroom research that could mean that one can plant a long-term seed towards teachers’ own research which can foster and sustain improvements in mathematics teaching and learning. However, both Philipp’s and Zack’s chapters also stress the enormous challenges and commitments that the engagement in teacher research puts on an already demanding profession – “one is speaking of two jobs” (Zack 1997, 187).

The need for different levels of support for teacher-researchers

Support and acknowledgement from university-based colleagues as well as school administrators are therefore crucial factors. Valero, Gómez and Perry (1997) in their chapter recognise that administrators need to be involved in school-based research in two ways – to contribute their expertise and to provide the necessary support for the teachers. However, Barbara Jaworski (1997, 178) furthermore raises an important question: “In what ways can the development of teaching through teacher research be a concept originating with and driven by teachers themselves?”. Chris Breen (1997) obviously shares a similar concern with respect to teachers who want to focus on their classroom as part of postgraduate studies and stresses their vulnerability which leads them to engage in research projects which they originally would not have chosen themselves. Student teacher researchers therefore should be encouraged to develop their own research questions as they grow professionally. The experience of collaborative relationships with peers might help to assist with the development of further research questions and the implementation and reporting of this research.

Student teachers as researchers

The involvement of student teachers as ‘teacher researchers’ concurs with the idea of developing a community of practice (Lave & Wenger 1991) in which they can experience how scientific analyses can help enlighten them to those aspects of classroom practice, professional skills and knowledge that they personally perceive as important (Jungwirth et al. 2001). In the context of a pre-service education system, student teachers can benefit in a similar way to classroom teachers. The Austrian/German mathematics education researchers Jungwirth, Steinbring, Voigt and

Wollring (2001) for example have shown this with respect to the 'interpretative classroom research' approach. They found that interpretative studies carried out by teacher researchers can help to reveal what is hidden in practice and what one has to understand in order to learn how to teach effectively and/or to change mathematics teaching. Respectively, Krainer (1998, 7) notes a current international trend in teacher education:

There are more and more international reports about involving (prospective or practising) mathematics teachers in research projects and integrating research components in teacher education courses where reflection and networking are important dimensions.

The participation of student teachers¹ in qualitative mathematics education research projects has become increasingly popular in several German universities. The current trend towards the integration of student teachers in qualitative research projects from the perspective of the responsible university lecturers has the following reasons:

While the student teachers are usually concerned with one sub-question within the research project, they also become familiar with the global research interest, methodological considerations and the analysis of a substantial part of the data because they work in co-operation with fellow student teachers who are also involved in the study.

They have the opportunity to draw their own conclusions and consequences with respect to research results obtained from their own and their fellow students' involvement. Therefore they are not solely dependent on research findings described in the literature and/or lectures.

They become sensitive to empirical findings and the respective research designs. Furthermore, they frequently experience how difficult it is to translate a supposedly rather simple empirical question into an appropriate research design, how many specifications are comprised in such a design and how differentiatedly a respective finding has to be assessed.

It is also expected that the active involvement in a didactical research project will help them not only to develop a rather 'imperative' perspective with respect to mathematics education in the sense of learning how to teach (best) but also in addition a 'diagnostical' perspective. This means that the students should learn what to expect in certain teaching and learning environments in order to adjust their instruction and individual student support accordingly.

This approach which is referred to as 'diagnostically enriched didactics' corresponds with recent developments with respect to the improvement of mathematics teaching and learning at the school level. Reform-oriented curriculum documents which follow a constructivist framework describe desirable teaching and learning environments in the mathematics classroom as open towards a variety of different ways to solve a set

¹ The student teachers usually use the results of their interpretative analyses as a basis for their *first teacher state exam* thesis which clearly has a scientific character and which together with written and oral exams concludes the university teacher based training program.

goal (a specific task or problem etc.), supportive of the different individual approaches and strategies, and communicative with respect to the discussion of individual approaches and results in order to reflect on sensible and necessary standardisations in mathematics.

In order to be able to manage the variety of different approaches chosen and explored by the pupils, the teacher has to be able to assess how each of these approaches can contribute to and influence the joint discussion. Therefore he/she will need diagnostic abilities on the basis of mathematical subject knowledge as well as knowledge about the social-interactive dimension of mathematics learning. Furthermore, it is a highly desirable aim of teacher education programs to enable prospective teachers to realise and understand the 'universal in the special case' and to approach the special case in a diagnostic way. Such a diagnostic approach is required in the daily practice of classroom teachers. This explains why classroom oriented research (and especially projects that include student teachers as qualitative researchers) should not solely focus on 'typical' effects in the sense of frequent classroom occurrence but also reflect on significant however less frequent cases. These cases and not so much the rather common and widespread ones present crucial challenges for teachers.

Interpretative classroom research

Most of the current German mathematics education research projects that involve student teachers are based on the 'interpretative research paradigm'. This methodological approach was developed by Heinrich Bauersfeld and his colleagues (1988). Interpretative classroom research seeks to investigate typical structures by analysing single cases which are regarded as exemplary. Their focus is the 'universal in the special case' and the goal of the interpretation is to comprehensively perceive and understand the (inter)actions of the observed individuals.

The significance of the interpretative research paradigm is related to an international change from content-based and individual-psychological approaches towards interpersonal human relations in (mathematics) education in the past decade. Current theoretically based research contributions increasingly stress the social dimension of both mathematics (Davis & Hersh 1981) and mathematics learning (Steffe et al. 1996) for the development and extension of mathematical knowledge.

The data collection and interpretation phases of studies employing the interpretative classroom approach usually follow a strict procedure consisting of four stages:

1. video recordings
2. comprehensive transcriptions of the video recordings with respect to either the full document or selected segments of the recording that are relevant to a respective research question(s)
3. the *sequential interpretation* of the data by an 'interpretation team' of four or five individuals (student teachers, teachers, teacher researcher)

4. the *specific interpretation* of the results on the basis of relevant literature and research findings by an individual student teacher researcher.

Interim findings with respect to student teachers' learning processes

According to the experiences of the author and fellow German colleagues, the student teachers' perception of the observed 'classroom research reality' demonstrates several phases (Wollring 1994). Immediately after the recording the participating students seem to underrate the richness of the pupils' contributions while they tend to overrate their own moderation and instructional abilities. Quite frequently they express their initial disappointment with the quality of the data collection and question the suitability of the data sample for in-depth-analysis. During the first viewings of the video document however these perceptions start to change and the performance of the children involved in the study appears to be richer than first envisaged. This impression often continuously increases during the transcription process when suddenly very informative and highly differentiated perspectives on the observed classroom episode arise. The following interpretative analyses frequently lead to the identification of further 'deeper' i.e. more differentiated/specialised research questions.

The value of the participation of the student teachers as 'teacher-researchers' in a current study on third and fourth graders' co-operative problem solving strategies (Peter-Koop) as well as in Wollring's (1994) study on kindergarten and elementary school children's understanding of probability is reflected in the self-evaluation of their work. An evaluation questionnaire that was given to the student teachers after the completion of their sub-project addressed the following aspects:

- individual motivation for their involvement in this interpretative project
- their learning about the underlying mathematical topic
- their experiences with co-operative learning during group work
- their dealing with the technical requirements of the study
- their experiences with the preparation of transcripts and data interpretation
- the benefits and difficulties of peer co-operation during the interpretation process
- their reflection on pupils' learning and their individual teacher behaviour.

Conclusions

In summary, the analyses of the student teachers' retrospective responses to the evaluation questionnaire suggest that the benefits of the interpretative classroom approach with respect to teacher preparation can be seen on three different levels, which of course may partly overlap:

The student teachers learn about an important aspect of elementary mathematics. However, one can argue that other learning environments within teacher education courses also facilitate learning about mathematical 'content knowledge' as well as

‘pedagogical content knowledge’. Their statements demonstrate that the student teachers learn to ‘listen’ to pupils with respect to their thinking and – in Peter-Koop’s current study – their collaborative problem solving strategies.

All student teachers who participated to date indicated that they appreciate their involvement, because it provides them with opportunities for intense observation of children and children's learning. They deal with and reflect on real examples of pupils’ behaviour, learning, interaction etc., which are believed to be more powerful than examples created by the lecturer (Jungwirth et al. 2001).

Finally, research designs that are based on the interpretative approach can enable the involved student teachers to learn about themselves as teachers. During the interpretation stages most student teachers used the opportunity to critically reflect on their individual classroom behaviour, interaction and instruction skills that became evident during their assistance of the pupils’ group work. One student teacher’s conclusion, which is representative for the majority of the replies, highlights the importance of active involvement and the opportunity for personal reflection of one’s actions for the individual student teacher:

In my opinion interpretative analyses are an important addition to lectures and school practicals. But you have to conduct the teaching yourself, be responsible for the transcription and actively involved in the interpretation of your transcript. Only then you can find out how well you can relate to children, learn about your mistakes and how children react to you.

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