

# Researcher-Teacher Relationships in Mathematics Education

Merrilyn Goos  
The University of Queensland  
<m.goos@uq.edu.au>

University-based mathematics educators typically rely on gaining access to teachers and students in schools or teacher education settings to conduct their research. In these circumstances it is more common for teachers to be co-opted into the research agenda than for genuine researcher-teacher collaboration to be realised. This paper proposes a framework for examining research spaces created by such relationships, illustrates its use by comparing three of my own research projects, and discusses implications for researchers working with teachers on mathematics education projects.

Most university-based mathematics educators would claim that the aim of their research is to improve the quality of mathematics teaching and learning; yet education research is often criticised for its lack of impact on, and relevance to, classroom practice. This so-called “research-practice gap” has sometimes been explained by reference to the different processes used by researchers and teachers to improve educational practice, and the different forms of knowledge that result. For example, Wiliam (2003) compares the analytic rationality of formal research that seeks to develop generalisations about educational phenomena with the practical inquiry of teachers who need to address immediate day-to-day problems. Thus the object of research, unlike in teaching, is not to solve problems but to create knowledge that helps us to understand a problem (Labaree, 2003). This tension between the aims of formal research and the needs of teachers is also evident in the often unequal relationships between researchers and teachers who participate together in classroom based studies. Breen (2003) argues that true collaboration can only be realised if there is sharing of control and decision-making between the participants. However, this is an uncommon occurrence as teachers are usually co-opted into the research agendas of university academics because the latter have greater access to power and resources. The result is a “bidirectional disconnect” (Heid, Middleton, Lawson, Gutstein, Fey, King, Strutchens, & Tunis, 2006, p. 79) where the complementarity of researchers’ and teachers’ knowledge remains unexplored.

The purpose of this paper is to examine some of the issues raised above and discuss implications for mathematics educators. To do this, I will outline a framework for analysing researcher-teacher relationships and then illustrate its use by comparing ways in which I worked with teachers in three of my own research projects. The analysis highlights characteristics of successful research collaborations and leads to questions about the role of university-based researchers working with teachers on mathematics education projects.

## Theoretical Framework

The issue of researcher-teacher relationships has been of interest to mathematics educators for some time. For example, a *Teachers as Researchers Working Group* first met at a PME conference in 1988. This was followed by various PME Discussion Groups (e.g., Novotná, Lebethé, Rosen, & Zack, 2005), a Research Forum (Novotná, Zack, Rosen, Lebethé, Brown, & Breen, 2006) and a Working Session (Novotná & Goos, 2007). At the latter Working Session, a framework was developed for analysing ways in which university academics and teachers might conduct research together (Table 1). The three elements of this framework arose from the questions and issues identified by Working Session participants in discussing their own experiences in conducting research with teachers.

**Table 1**

*Framework for Analysing Researcher-Teacher Relationships*

Beginning the partnership	Participants	Purposes of the research
How?	Roles & expectations	Topic (who chooses?)
<ul style="list-style-type: none"><li>• Seeking a teacher</li></ul>	Language	Research questions (whose?)
<ul style="list-style-type: none"><li>• Teacher seeks you</li></ul>	Trust/relationships	Benefits (for whom?)
<ul style="list-style-type: none"><li>• Enforced participation</li></ul>	Communities & asymmetric needs	

The main question considered in *beginning the partnership* was how teachers enter into this process and who initiates the research. At times, for example, a university-based researcher seeks out one or more teachers to participate in a project that has already been planned. Occasionally a partnership might be initiated by a teacher who seeks out a university-based researcher. Some Working Session participants noted that teachers could be encouraged or required by a school administration or government education department to enter into a university-based research project. In all these instances we need to consider “why” as well as “how” such research partnerships are initiated.

Several questions relate to the *participants* themselves. The extent to which roles are shared between teacher and researcher came under scrutiny; for example, there may be benefits and disadvantages in either maintaining strong role boundaries or sharing/swapping roles (teacher-as-researcher or researcher-as-teacher). However roles are determined, it was agreed by Working Session participants that expectations need to be made clear from the start as a foundation for building trust and mutual respect. Malone (2000) has argued that since teachers and researchers create and act upon two different types of knowledge (practical inquiry in particular contexts versus theoretical inquiry aiming at generalisation), they belong to two distinct communities, or sub-cultures, with intersecting interests but asymmetric needs. That these two communities also use and value different forms of language presents a challenge for communicating the findings of research to non-researcher audiences, such as teachers and policy makers.

*Purposes of the research* may depend upon how the partnership is initiated, since this often influences the choice of topic, negotiation of research questions, and realisation of any benefits for theory, practice, or policy development.

In the next part of the paper I use the framework sketched out above to compare researcher-teacher relationships in three contrasting research projects I have conducted over the last 14 years. The first project highlights the development and gradual transformation of a long term collaborative relationship between myself as a university-based researcher and a school teacher as we carried out classroom research together. The second project was a longitudinal study of the transition from pre-service to beginning teaching, and the third project was commissioned by the government to support implementation of a new mathematics curriculum by working with teachers to expand their pedagogical and assessment repertoires.

### A Collaborative Research Relationship: Project #1

Since 1994 I have carried out research with a teacher (Vince) who shares my interest in secondary school students’ mathematical thinking (see Goos & Geiger, 2006; Geiger & Goos, 2006 for extended discussions of this collaboration). I conducted most of my PhD research in Vince’s classroom, and we have since collaborated in other projects. *Initiation of the partnership* came about when we were introduced by our former pre-service teacher education lecturer, who had become my PhD supervisor. At the time, Vince had recently completed a Masters degree and was motivated to participate in my research by his desire to resume regular professional conversations with someone like his former university supervisor. Thus there was some equity in the partnership from the start in terms of its initiation and the underlying motivations of the participants.

As *participants*, although we agreed to keep our roles separate – myself as non-interventionist researcher and Vince as teacher – the nature and distinctiveness of these roles changed over time as we developed mutual trust. I was a novice researcher as well as a novice teacher, and thus I was conscious of the kind of respectful relationship that needed to be established with this very experienced teacher if the research was to be productive. Vince later explained how he valued my presence as “someone who can see with non-judgmental and different eyes who views the world of the classroom through an analytical lens that seeks to understand rather than to prescribe action” (Geiger & Goos, 2006, p. 256). However, my efforts to understand did eventually lead Vince towards specific actions so that over time I became more of a participant than a passive observer. For example, our post-lesson discussions about classroom events and my conversations with students often led Vince to modify his teaching plans for the next lesson. He explained:

The interesting thing for me as a teacher was to think about what made it happen in that way, can we replicate this? ... Could we manipulate what was happening to bring about particular types of learning and interaction between students? (Goos & Geiger, 2006, p. 38)

Vince and I explicitly negotiated issues related to power and what each of us wanted to achieve out of the collaboration as we began to write and present papers together at research conferences. Vince believed that “teachers’ voices ... have to be heard if research is going to make a difference to teaching and learning in schools” (Goos & Geiger, 2006, p. 38), and he saw jointly authored publications as acknowledging his equal contribution to creation of the new knowledge reported therein. Likewise, I gained credibility with practising teachers through joint presentations at professional development conferences where Vince was well known because of his leadership and advocacy roles in teacher professional associations. This was how we introduced each other into the distinct sub-cultures of mathematics education to which we separately belonged – the community of educational researchers and the community of teachers – and how we learned to communicate with different audiences using the language of research and the language of practice. Thus our needs, although different, were mutually recognised and valued.

Initially the *purposes of the research* were determined by my own interests in that I proposed the topics and research questions. This situation has evolved into a more equal arrangement since Vince enrolled in a PhD, under my supervision, and later began to formulate his own research plans. He has now left his job as a school teacher and moved into a new position as a university academic, but our collaboration continues on a range of other projects.

### Research with Pre-Service and Beginning Teachers: Project #2

My second example is typical of research conducted by mathematics teacher educators with their pre-service students. The aim of project #2 was to investigate and compare the pedagogical practices and beliefs of pre-service and recently graduated teachers in integrating digital technologies into the teaching of secondary school mathematics. This was a longitudinal study over three years (2002-2004) in which I followed three successive cohorts of my own pre-service students into their early years of teaching (see Goos, 2005; Goos & Bennison, 2008, for details).

In a sense this *partnership was initiated* as soon as the students enrolled in my course and therefore became prospective research participants. The research design had two components: (a) a survey-based cohort study of practicum experiences in technology integration experienced by the group as a whole; and (b) individual case studies of selected pre-service teachers that allowed snapshots of experience to be captured at developmental stages during practicum sessions and the first year after graduation. I invited all my students to participate in the surveys, and then selected a small number for individual case study (lesson observations and interviews) based on research criteria that involved sampling a range of different school settings, including government and independent schools in capital city and regional locations, with differential access to technology resources.

There was no sharing of teacher and researcher roles amongst *participants*, but role boundaries became blurred in another way in that I filled the dual roles of teacher educator and researcher. Adler, Ball, Krainer, Lin, and Novotna (2005) pointed out that this personal investment in teaching makes it difficult for us to take a critical stance towards the research we do with prospective and practising teachers, even though it may assist in building the trust that is needed to establish productive research relationships. While recruitment of students was carried out in accordance with the university’s ethical guidelines, their participation may have been motivated by their relationship with me as the teacher-educator-researcher, and in such circumstances it is difficult to negotiate the power relationship that exists between teacher educators and their students. Although I helped the pre-service teachers to publish their technology integration work in professional journals (e.g., Quinn & Berry, 2006), I did not seek out opportunities for them to share their research experiences with a wider audience. Instead, I filtered their experiences through my own research perspective when I communicated findings from this project to the research and professional communities (Goos, 2005, 2006).

The *purposes of the research* arose from my experiences of teaching previous cohorts and my observations of the potential for technologically knowledgeable pre-service and beginning teachers to act as change agents in schools (Marcovitz, 1997; Weinburgh, Smith, & Smith, 1997). Thus the teacher-participants unknowingly influenced the topic and research questions without having any direct input into their formation. Several of these beginning teachers later approached me to volunteer for other research projects, which may indicate they gained some benefit from participation.

### Research-Based Professional Development: Project #3

The third contrasting example was a professional development project carried out in 2005-2006 that supported a group of secondary mathematics teachers in planning and implementing mathematical investigations, consistent with the intent of a new syllabus (see Goos, Dole, & Makar, 2007, for details). The main challenge for teachers implementing the syllabus lay not only in using a new structure for curriculum planning, but also in designing learning experiences and assessment tasks that take an investigative approach to working mathematically. Four pairs of teachers in four schools located in the same geographical region participated in the study. We made three visits to the region over a five month period to work with the whole group of teachers, each time for two consecutive days.

This *partnership was initiated* by the State education department, which provided funding to several universities for professional development projects to support initial syllabus implementation. The department nominated the education district in which the project was to be conducted, and asked school principals in the district to recruit teachers. As a result, we did not meet the teachers until our first visit. Although we played no part in initiating the researcher-teacher relationships in this project, we nevertheless discovered that all the teachers had volunteered to participate because they were looking for ideas about taking a more investigative approach to their classroom practice, and some were already experimenting with investigative approaches to mathematics teaching.

We maintained clear role distinctions as *participants* who were either teachers or researchers. However, as with Project #2, the researchers filled dual roles, this time as professional developers who were expected to bring about change in teaching practice. A key element to our research design was to align the project goals with the needs of the teachers. In particular, we recognised the importance of providing teachers with authentic, practice-based learning opportunities that included examples of mathematical investigations, opportunities to experience these investigations as learners themselves, and opportunities to share their ideas and experiences with colleagues, including the challenges encountered and their insights into the process. We discussed these principles at the start of our first visit, together with expectations regarding the iterative research approach that required teachers to plan, implement, and evaluate at least two units of work. It was difficult to build trust between researchers and teachers due to the very short duration of this project and the limited nature of our interactions with the teachers. However, by the time of our third research visit, we had established sufficient familiarity and trust to go to the teachers' schools, observe and videotape lessons, and use the videotapes as a stimulus for a post-lesson discussion.

Similarly to Project #2, as researchers we have communicated our findings to the research and professional communities (Goos, 2007; Goos, Dole, & Makar, 2007). Additionally, at the end of the project the State education department planned a forum where participating researchers and teachers could co-present their experiences to an audience of senior teachers and education district officials. Several of the teachers who participated in the project have since taken leadership roles within their district in providing professional development to their peers. The project has thus provided the teachers with opportunities to share their practical inquiry with colleagues in other schools.

The broad *purposes of the research* were determined by the State education department, but the pedagogical focus of the project was at the discretion of the researchers and teachers. The teacher participants identified their own personal goals (topics) and these shaped their planning, implementation, and refinement of units of work. When discussing overall impact some teachers claimed they now had greater understanding of mathematical investigations. A few commented that it was unlikely significant change would have occurred without the impetus provided by this project, because the opportunity to participate validated the changes in teaching practice that they wanted to achieve. Several of the teachers also mentioned that working with university researchers had enhanced their status as professionals in the eyes of their colleagues. While all the teachers seemed to benefit in some way from their participation, at times we – the researchers – felt challenged by teacher beliefs and school cultures that were not supportive of investigative teaching approaches.

## Conclusion: Implications for Mathematics Educators

Table 2 summarises features of the researcher-teacher relationships in the three projects and highlights *mutuality* of motivations, roles, purposes, and links between communities as a key characteristic of genuinely collaborative researcher-teacher relationships (project #1).

**Table 2**

*Comparison of Researcher-Teacher Relationships in Three Projects*

<b>Feature of researcher-teacher relationship</b>	<b>Collaborative research relationship (project #1)</b>	<b>Pre-service &amp; beginning teachers (project #2)</b>	<b>Professional development (project #3)</b>
Beginning the partnership	Initiation: mutual colleague.	Initiation: researcher seeks teachers (own students).	Initiation: State education department.
<ul style="list-style-type: none"> <li>• How?</li> <li>• Motivation?</li> </ul>	Motivation: mutual interest in research topic and process.	Motivation: students' relationship with researcher-teacher-educator?	Motivation: desire to improve teaching and learning?
Participants	Separate roles but some blurring; explicit expectations.	Researcher as teacher educator; implicit expectations.	Researcher as professional developer; explicit expectations.
<ul style="list-style-type: none"> <li>• Roles</li> <li>• Expectations</li> <li>• Language</li> </ul>	Trust established over extended time.	Trust relies on teacher-student relationship.	Difficult to build trust over short time span.
<ul style="list-style-type: none"> <li>• Trust/relationships</li> <li>• Communities</li> <li>• Asymmetric needs</li> </ul>	Complementary knowledge explored; researcher & teacher communicate findings to both communities.	Separate researcher & teacher knowledge; researcher communicates findings to both communities.	Separate researcher & teacher knowledge; some shared communication of findings to both communities.
Purposes of the research	Topic & research questions defined by researcher but evolve over time.	Topic & research questions defined by researcher.	Topic defined by government, research questions by researchers & teachers.
<ul style="list-style-type: none"> <li>• Topic</li> <li>• Research questions</li> <li>• Benefits</li> </ul>	Mutual academic & professional benefits.	Academic benefits for researcher, implicit professional benefits for teachers.	Academic benefits for researcher; some professional benefits for teachers

This brief exploratory analysis suggests a way of mapping out the research space occupied by university-based mathematics educators who carry out research with pre-service or practising teachers. It also raises questions about the role of university-based researchers, especially when they are also teacher educators or professional developers in relation to the teachers participating in the research project.

### *Implications for Researchers as Teacher Educators*

1. How can pre-service teacher educators negotiate ethical issues (unequal power) in researching with their own students?
2. How can pre-service teacher educators develop a critical stance (distance and scepticism) towards the research they conduct with their students?



In reflecting on the emerging field of mathematics teacher education Krainer noted that teacher educators have the dual roles of “intervening and investigating ... of improving and understanding” (Adler et al., 2005, p. 371). In the same article Adler suggested that in order to fulfil our dual roles as teacher educators we need to develop effective theoretical languages to distance ourselves from what we are looking at. Perhaps scepticism and distance might also be achieved by subjecting our own practice to the scrutiny of teacher education colleagues in other institutions and countries via collaborative projects.

### *Implications for Researchers as Professional Developers*

3. Who has the right to “transform” teachers and teaching practice?
4. How can researchers working with teachers balance transformation with critique in ethical and intellectually honest ways?

Each of these questions reflects the challenges of conducting professional development projects where there is an expectation that teaching practice will be transformed for the better. Labaree (2003) pointed out that researchers and teachers speak different languages and work within different paradigms (analytical vs practical), and these cultural differences need to be negotiated with care in order for researchers and teachers to build mutual understanding of, and respect for, each other’s knowledge.

### *Implications for Linking Research and Practice*

5. In communicating findings from research with teachers, who should speak for whom and to whom?
6. What conditions are needed for researchers and teachers to explore each other’s roles and understand how their respective communities develop generalised versus particularised knowledge of teaching and learning?

The final two questions invite readers to consider how researchers and teachers – representing two different communities with intersecting interests and asymmetric needs – might work together to develop and communicate “principled practice” (Heid et al., 2006, p. 78). The framework for analysing researcher-teacher relationships presented in this paper may provide a starting point for this important endeavour.

## References

- Adler, J., Ball, D., Krainer, K., Lin, F-L., & Novotná, J. (2005). Reflections on an emerging field: Researching mathematics teacher education. *Educational Studies in Mathematics*, 60, 359-381.
- Breen, C. (2003). Mathematics teachers as researchers: Living on the edge? In A. Bishop, M. Clements, C. Keitel, J. Kilpatrick, & F. Leung (Eds.), *Second international handbook of mathematics education* (pp. 523-544). Dordrecht: Kluwer.
- Geiger, V., & Goos, M. (2006) Living in the gap: A tale of two different types of researchers. In P. Grootenboer, R. Zevenbergen, & M. Chinappan (Eds.), *Identities, cultures and learning spaces* (Proceedings at the 29<sup>th</sup> annual conference of the Mathematics Education Research Group of Australasia, pp. 254-261). Sydney: MERGA.
- Goos, M. (2005). A sociocultural analysis of the development of pre-service and beginning teachers’ pedagogical identities as users of technology. *Journal of Mathematics Teacher Education*, 8(1), 35-59.
- Goos, M. (2006). Licence to thrill or live and let die? *Principal Matters*, 68, 6-8.
- Goos, M. (2007). An investigative approach to teaching secondary school mathematics. In K. Milton, H. Reeves, & T. Spencer (Eds.), *Mathematics: Essential for learning, essential for life* (Proceedings of the 21<sup>st</sup> biennial conference of the Australian Association of Mathematics Teachers, pp. 68-74). Adelaide: AAMT.
- Goos, M., & Bennison, A. (2008). Developing a communal identity as beginning teachers of mathematics: Emergence of an online community of practice. *Journal of Mathematics Teacher Education*, 11(1), 41-60.
- Goos, M., Dole, S., & Makar, K. (2007). Designing professional development to support teachers’ learning in complex environments. *Mathematics Teacher Education and Development*, 8, 23-47.
- Goos, M., & Geiger, V. (2006). In search of practical wisdom: A conversation between researcher and teacher. *For the Learning of Mathematics*, 26(2), 37-39.

- Heid, M., Middleton, J., Lawson, M., Gutstein, E., Fey, T., King, K., Strutchens, M., & Tunis, H. (2006). The challenge of linking research and practice. *Journal for Research in Mathematics Education*, 37(2), 76-86.
- Labaree, D. (2003). The peculiar problems of preparing educational researchers. *Educational Researcher*, 32(4), 13-22.
- Malone, J. (2000). Bridging the gap: A challenge for the dual community. In J. Bana & A. Chapman (Eds.), *Mathematics education beyond 2000* (Proceedings of the 23<sup>rd</sup> annual conference of the Mathematics Education Research Group of Australasia, pp. 27-36). Sydney: MERGA.
- Marcovitz, D. M. (1997). Technology and change in schools: The roles of student teachers. In J. Willis, J. D. Price, S. Macneil, B. Robin, & D. A. Willis (Eds.), *Technology and teacher education annual, 1997* (Proceedings of the eighth international conference of the Society for Information Technology and Teacher Education (SITE), Orlando, FL, April 1-5, 1997) (pp. 747-752). Charlottesville VA: Association for Advancement of Computing in Education. (EDRS Document Number ED412921).
- Novotná, J., & Goos, M. (2007). Teachers researching with university academics. Working Session 2. In J. Woo, H. Lew, K. Park & D. Seo (Eds.), *Proceedings of the 31<sup>st</sup> conference of the International Group for the Psychology of Mathematics Education* (Vol. 1, p. 188). Seoul: PME.
- Novotná, J., Lebethe, A., Rosen, G., & Zack, V. (2005). Research by teachers, research with teachers. Discussion Group 4. In H. Chick & J. Vincent (Eds.), *Proceedings of the 29<sup>th</sup> conference of the International Group for the Psychology of Mathematics Education* (Vol. 1, p. 207). Melbourne: PME.
- Novotná, J., Zack, V., Rosen, G., Lebethe, A., Brown, L., & Breen, C. (2006). Teachers researching with university academics. Research Forum 1. In J. Novotná, H. Moraová, M. Krátká, & N. Stehliková (Eds.), *Proceedings of the 30<sup>th</sup> conference of the International Group for the Psychology of Mathematics Education* (Vol. 3, pp. 209-216). Prague: PME.
- Quinn, D., & Berry, R. (2006). Modelling and the transit of Venus. *Australian Senior Mathematics Journal*, 20(1), 32-43.
- Weinburgh, M., Smith, L., & Smith, K. (1997). Preparing preservice teachers to use technology in teaching math and science. *Techtrends*, 42(5), 43-45.
- William, D. (2003). The impact of educational research on mathematics education. In A. Bishop, M. Clements, C. Keitel, J. Kilpatrick, & F. Leung (Eds.), *Second international handbook of mathematics education* (pp. 471-490). Dordrecht: Kluwer.

