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Chapter 3

Exploring Mixed Roles and Goals in Collaborative Research: The Example of Toddler Mathematics Education



Camilla Björklund and Hanna Palmér

Abstract This chapter focuses on the methodological possibilities and challenges arising from the mixed roles and aims between researchers and teachers in a research project aimed at developing educational practices with toddlers. The project was conducted in close collaboration between researchers and preschool teachers in Sweden for three semesters using an iterative design of meetings every 2 weeks to evaluate, develop, and plan teaching activities for toddlers. The key questions concerned deepening the knowledge, both theoretically and empirically, of how children develop numerical skills and how this development can be facilitated in early childhood education. Due to the specific context in which the research and development were undertaken, methodologies previously used in research on early mathematics had to be further developed. During the close collaboration in carrying out the project, unanticipated methodological challenges involving the mixed roles and goals of the collaborators did arise but turned out to enrich the knowledge for all participants. The challenges concerned both the common goal to learn more about early mathematical learning and the diverse approaches with which preschool teachers and researchers entered the project.

Introduction

Preschool is the first step in the education system in the Swedish context, and the Education Act (SFS 2010:800) states that every child in education should participate in teaching that offers them opportunities to develop and learn basic skills and values. This also concerns the youngest children enrolled in education (starting with

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1-year-olds) and the content of mathematical knowledge and skills. However, unlike what is common in steering documents for education in several other countries, neither the Education Act nor the Swedish National Agency for Education offers information on *how* this teaching is to be conducted. Thus, the Swedish governing document presents the goals for the education but little guidance in how to design the teaching.

The question of *how* to teach mathematics with toddlers (children under the age of 3) concerns both the field of mathematics education research and the teaching practices in preschools with young children. The teaching is to be based on scientific knowledge and empirical good practice, which means that researchers and teachers should join forces in a commitment to develop high-quality education. Thus, *how* to conduct mathematics teaching for 1-year-olds is both a theoretical and an empirical question that needs to be investigated in preschool, in collaboration between researchers and teachers.

Taking a Children's Perspective

There is an abundance of research on young children's numerical understanding and development of arithmetic skills. Most research takes a cognitive perspective (e.g. Carpenter et al., 1982; Fuson, 1992; Baroody & Purpura, 2017), describing mental processes of constructing knowledge as putting pieces of knowledge together into schemas (see Steffe, 2004). This research, based on cognitive theories, often describes what children are and are not able to do in a consecutive order of advancing skills; that is, the focus is on *development*. But, while the interest in these studies is not generally in how to facilitate the learning of numerical understanding and arithmetic skills, this is a highly essential question for early childhood education. To indulge in these pedagogical questions, we suggest a change in the theoretical perspective to rather take a phenomenological approach, in which the departure point is how the world (e.g. numbers and arithmetic principles) appears to a child. This approach is also more familiar to preschool teachers, who on a daily basis meet children who experience mathematical phenomena in sometimes very different ways than adults do. For preschool teachers, being sensitive to the child's perspective and way of understanding is more practicable than trying to 'read' what cognitive processes lie behind a child's acts and utterances. Furthermore, taking a children's perspective – that is, how they make sense of something (Sommer et al., 2010) – as a guiding star is also powerful for developing theoretical knowledge of how to teach mathematics to young learners, as how children make sense of something directs attention to how the teaching can help the child broaden his or her way of experiencing the learning objects, that is, what numbers mean and what is possible to do with them. This was the basic approach in the project that is the empirical example in this chapter, a development and research project conducted in preschools with toddlers, aiming to empirically investigate *what* constitutes toddlers' learning

of numbers and emergent arithmetic skills and *how* early childhood education can facilitate this learning.

Theoretical and Empirical Interest in Toddlers' Learning

The project, carried out by 2 researchers, 3 preschool teachers, and 27 toddlers, was funded by an agency¹ that particularly emphasises collaborative research between teachers and researchers with the purpose of developing educational practices. This meant that teachers and researchers came together already in the project's planning stage, before funding was received, to formulate research questions and outline the project's design. Once the project was launched, the collaboration continued for 3 years in an iterative process of recurring meetings every 2 weeks. At these meetings, activities were planned, conducted activities were evaluated, and possible learning outcomes and shortcomings were discussed, as were different interpretations of toddlers' acts and utterances. These discussions resulted in revisions to teaching acts and activities, new ideas for how to conduct or develop an activity, and plans for what would be particularly focused on until the next meeting. The teachers documented their activities in videos and uploaded them onto a secure common server that enabled the researchers and teachers to see what was enacted in the preschools. These documentations thus generated data not only for the concurrent development of activities but also for further analyses of children's learning over a prolonged period of time. Figure 3.1 shows an overview of the project and the different modules.

The project built on collaboration in which teachers and researchers added their competencies to the collective knowledge. In Year 1 preparations were made for the study, such as ethical clearance application and pertinent consent forms for the participating children's legal guardians. This first year also included a thorough piloting of the assessment tool that was to be used to follow the children's learning. Activities were also conducted to deepen the collective understanding of the theoretical underpinnings for teaching (in this case, variation theory of learning; Marton, 2015) and how these might be implemented in teaching activities.

The assessment tool was designed as play-based conversation, framed as a story about a cat who invites friends to a birthday party. This frame was chosen because it was hopefully a familiar setting to the toddlers, in which dividing and sharing, playing games, and creating sets of items would be natural occurrences and inspire the children to take part in conversations about the cat and the events that occurred. In this setting, the teachers invited the children to play the narrative together with them by participating in a variety of tasks with numerical content, in a naturalistic preschool setting. The tasks embedded in the narrative were developed at five levels of difficulty, whereby the teachers were to follow a manuscript but at the same time

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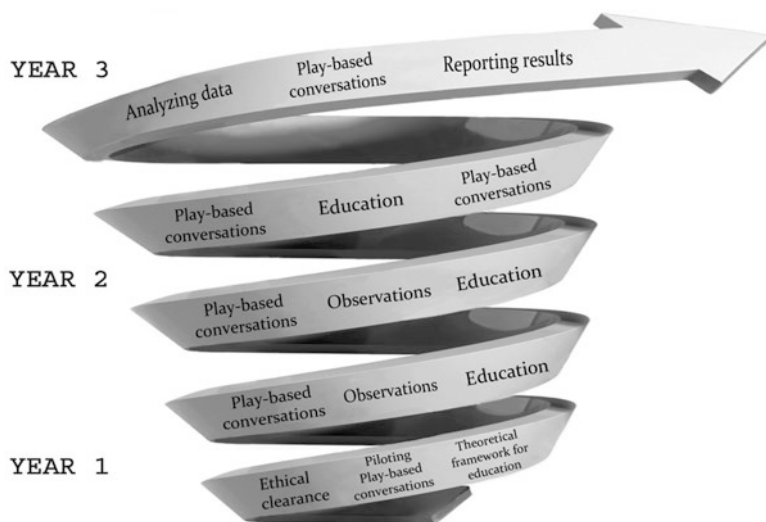


Fig. 3.1 Overview of the project, the iterative collaboration process, and the different modules

be sensitive to the toddlers' responses. The second semester and the beginning of the second year of the project followed a similar design, with play-based conversations conducted by the teachers at approximately 6-month intervals.

One observation each in the second and the third semester was also conducted by the researchers visiting the preschools, to capture instances of children's spontaneous engagement in preschool activities. Together, the observations and play-based conversations were significant for the general outline of the teaching activities enacted by the teachers for three semesters, with recurring meetings to evaluate and revise the teaching. The teachers' experiences strongly influenced the development of the activities concerning communicative approaches (i.e. how to attract the children's interest) and making use of available resources, while the researchers' analytical approach to the acts and implementation of theory helped in both evaluating the potential of an activity and further developing practices on a scientific basis. The third year of the project was more focused on scientific analysis and reporting of project results, but even in this process, the teachers were invited to participate, for example, in presenting the project at conferences and in different fora for communication (e.g. publications and feedback to their co-workers at the preschools as well as to parents).

The project showed high potential for developing theories on early numerical learning and how learning may be facilitated in preschool education with toddlers, on a scientific basis. The large amount of data generated and the longitudinal design enabled for thorough analyses of learning both within and between children and within and between the designed teaching. Results show, for example, the potential for teaching and learning in preschool when taking one's starting point in games, songs, and book reading and thus in the interests shown among children within the

preschool context (see Björklund & Palmér, 2022; Palmér & Björklund, 2022). A crucial aspect was to alter these common activities, based on both theoretical underpinnings and pedagogical competencies in action, in order to afford the children experiences and explorations that facilitated their learning.

Key Features for Generating Valid and Reliable Results

One important key for generating scientifically solid results was measuring the toddlers' learning progress (did the teaching have the intended effects?). To accomplish this, we needed to generate valid data on the toddlers' knowledge, even though verbal skills among them were limited. This in turn required a new way of thinking about knowledge and skills in mathematics. To generate valid data, the tasks in the play-based conversation (see above) were designed on the theoretical principles of variation theory of learning (see Marton, 2015). The tasks were to simultaneously adhere to the children's experiences and their different ways of understanding (Björklund & Palmér, 2021). The children were invited to participate in these tasks with numerical content, and based on their actions, we could explore their ways of understanding basic features of numbers and what content the teaching should emphasise. However, to orchestrate such an investigation, we found it critical to involve the teachers in conducting these play-based conversations, as it was not reasonable to believe that an outside researcher, who did not know the toddlers, would be able to interact and communicate with them in a way that gave them the best conditions for demonstrating their knowledge. Toddlers' expressions are sometimes highly subtle and demand exclusive knowledge of the individual child's ways of expressing him/herself. Thus, the design of the tasks and having the teachers conduct the play-based conversations increased the internal and ecological validity in favour of external validity.

Another central issue in the project was to study teaching activities and what aspects of them facilitated learning, thus focusing on principles that seemed to guide successful teaching. Based on observations, in collaboration we redesigned common preschool activities based on both theoretically and empirically discovered principles. This part of the study required close collaboration, including different competencies, in which the teachers' knowledge of the conditions for teaching and the available artefacts and resources, and not least their pedagogical skills in conducting the designed activities with sensitivity to the children's needs and responses in the situation at hand, were indispensable. One feature of redesigning the common preschool activities was stretching their potential as means for teaching about number meaning. From this followed the necessity to adapt the content addressed in the activity to the aspects of numbers that a particular child had not yet discerned. Adapting activities in accordance with each child's preconditions in order to help them learn to their fullest potential is in line with the Education Act (SFS 2010:800) and the United Nations Convention on the Rights of the Child (UN, 1989) and is thus a foundational approach in early childhood education and care. For instance,

playing a memory game with dots on cards to make pairs of was found to be very differently challenging to different children, and in their teaching acts, the teachers had to decide what kind of pairs (similar or different patterns) and number of dots (1–3 or 1–4 dots in total) would be appropriate in order to present the child with a challenge that would extend their experience of numbers while retaining their interest in the game (reminiscent of Vygotsky's Zone of Proximal Development). This could only to a limited extent be planned beforehand based on theoretical principles and observations; instead, the outcome of the interaction and playing the game in the particular situation was taken as the basis for didactical decisions. Due to the closeness to the preschool setting and familiar activities, the internal and ecological validity increased, again in favour of external validity.

As described above, the project's outcome and success in many ways depended on the close collaboration and contribution of the project members' different competencies. Below we will elaborate on the methodological challenges that emerged in the project, which involved both the common goal to learn more about early mathematical learning and the diverse approaches with which the preschool teachers and researchers entered the project.

The Challenges of Collaboration

Collaboration between researchers and teachers is not a new phenomenon. There have been many projects, often within the frame of action research, in which questions relevant to both researchers and teachers have been researched and practices respectively concerning the two groups have been developed. Many teachers have also been involved in courses, academic programmes, and in-service training in which research results and methods have been embodied. Even so, collaboration between researchers and teachers in joint projects has recently become more common. This has been especially evident in Sweden, where government enterprises are encouraging developmental projects in collaboration between researchers and teachers, in which the competencies and questions of both parties are attended to (see, e.g. commissioned by the Swedish government: Instructions for the Swedish Institute for Educational Research, SFS 2014:1578, and the national ULF project, Committee on Education, Dir. 2017:27).

Joint Project But Diverse Goals

Research is a different activity to teaching, which consequently means that a teacher's competencies do not necessarily help in research on toddlers, in the same way as a researcher's competencies do not necessarily help in teaching toddlers. Thus, in collaborative projects we have to bear in mind that participants are both insiders and outsiders (McKenney & Reeves, 2019) in the joint project, even though the project

goals may be shared on some levels. That said, we argue that both perspectives are necessary.

In projects aimed at contributing both theoretically and empirically to a certain field of knowledge, it is possible to distinguish diverse goals of teachers and researchers. For example, the researchers' aim is often primarily to gain deeper knowledge of underlying structures and discourses in the teaching and learning process, while teachers may primarily seek methods and means to ease their daily practice in relation to current conditions, curricula, and specific (local) contextual factors that influence what is seen as possible to develop and do. Or, the researchers aim to change practice through new knowledge, while the teachers aim to implement and adapt new knowledge to existing conditions. All these aims are highly relevant for developing educational knowledge but are foregrounded to different extents. A typical example from the project presented here is the rare opportunity to teach a group with only a few children at a time in a preschool practice that is often understaffed and where available spaces are limited, while the scientific study of principles for teaching a specific content might require limiting the number of possible interactions to enable systematic and valid analyses. In our case, the support for the project by the head of the preschool was found to be crucial, enabling both time and space for the teaching activities. This was also enabled by economic compensation for stand-in personnel, included in the project budget already in the application for funding.

Collaboration between researchers and teachers provides opportunities to bring to the fore both outsider and insider perspectives (McKenney & Reeves, 2019), which contributed to our understanding of the contributions of different perspectives in our project as well. In an ideal setting, researchers learn from practitioners, e.g. through adaptations of interventions that meet teachers' goals in ways different to those conceived by their designers, and vice versa. Another reason for cooperation is that, without the involvement of teachers, it is difficult to gain clear insight into potential curriculum implementation problems and to generate measures to reduce these problems. New interventions, however imaginative their design, require a continuous anticipation of implementation issues, involving not only 'social' reasons for withholding commitment to a joint project but also 'technical' benefits for improving the innovations' fitness for survival in real-life contexts (Van den Akker, 2010). Van den Akker thus holds that the professional development of *all* participants is key to optimising curricular interventions. He further observes a change in research concerning how to perceive teachers' role in educational science, whereby the emphasis was previously on 'fidelity' but is now turning to teachers having agency in their implementation of an innovation in their teaching practice. This may be done through active engagement in the planning and evaluation of enacted teaching.

Different Approaches But Interchanging Roles

One way of describing collaborative projects is that the participants have different roles, with, for instance, the researcher serving as the outsider to the teaching practice but providing a community (field of research) in which the research and questions originating from the teachers' (insiders') lived experiences can be shared and common issues addressed.

Wagner (1997) highlights two issues that have been raised in reflections on collaborative research and development in educational science: first, the difficulty in generating knowledge useful for educational practice if one does not collaborate with teachers and, second, the asymmetry of power and knowledge that might arise between researchers and teachers. Wagner proposes a typology of social organisation within which individuals participate in a co-oriented social activity that puts the asymmetry in perspective. Wagner also outlines that symmetry does not necessarily have to be a primary goal in the collaboration; the need for symmetry depends on the focus of the research and particularly on the research question and the structure of inquiry.

In an asymmetric collaboration, according to Wagner (1997), the different perspectives of the participants (researcher and teacher) are accepted, and the different kinds of expertise they bring to the research are valued but *are not expected to be shared* or mediated between participants. In many educational research projects, we can see asymmetrical collaboration whereby the researcher is often the agent of inquiry and the teachers' work is the object of analysis and development. But they are engaged in *jointly defined work*, which means that the partners acknowledge and value each other's skills and knowledge. In this relationship, both researchers and teachers are the agents of inquiry, while the object of inquiry is still the members of the educational practice. A third kind of collaboration, according to Wagner (1997), is characterised by *co-learning agreements*. This collaboration draws on knowledge that is generated through research in which both researchers and teachers are equally responsible for initiating changes. The latter collaboration, with teachers engaged in investigating their own practice, seems to induce development in discourse and educational changes to a higher degree than does the asymmetrical collaboration in which the researchers are the ones with agency of inquiry and the (pre)school is made the object of inquiry. Now, the kind of collaboration that is established is also related to what kind of knowledge the research will be able to contribute; that is, what type of research questions and research designs are applicable.

Jaworski (2003) presents a framework for understanding so-called co-learning in research that includes researchers exploring from the outside and/or teachers exploring from the inside and, ultimately, the value of these practices influencing each other for improved teaching. Researchers and teachers are both participants in processes of education and systems of education. Both are engaged in action and reflection, and by working together, each might learn something about the world of the other as well as his or her own world and its connections to different institutions. Nevertheless, in our experience, the dimensions 'insider' and 'outsider' are not

dichotomies or outermost poles that propose some form of dualism, as each participant enters a project with a subjective understanding of its goals, roles, and approaches. This means that what is learnt is not the same – of the same form or at the same level – for all.

In different kinds of collaborative studies, teachers and researchers have different approaches to the project and to the roles their collaboration entails. If participants in a project expect themselves to have more or less power than the collaboration type entails, they might face difficulties. The close collaboration that takes its departure in the conducted practices in our project (documented in video recordings for all participants to share) offers help in avoiding several problems concerning implementing research results or new knowledge in preschool settings, bridging potential stereotyped roles (such as insider/outsider). Namely, there is no need for a ‘translation’ of new knowledge to be adapted by teachers, since the research starts in their practices and ends in developing the same practices (see also Pramling et al., 2019). Nevertheless, the learning of one participant is dependent on the participation and learning of the other, while both are engaged in a common activity for mutual benefit. In this process, establishing intersubjectivity and coordinating perspectives by explicating and clarifying expectations and what one means are necessary components of the collaboration (see Pramling & Peterson, 2023, Chap. 10).

In our project the aim was set to investigate *how to facilitate learning*, as a common ground for engagement, which is heavily practice-oriented and relevant for developing teaching both in the preschool teachers’ daily work and in educational science. As described above, the data generation and teaching activities could not have been conducted in another kind of collaboration than what Wagner and Jaworski frame as co-learning, but we also discovered that the kind of collaboration changed during the project. In some parts, not least when reporting the study, we indeed had a jointly defined work type of collaboration in which the educational work conducted by the preschool teachers was analysed in detail. Participating in these parts of the project required a great deal of courage from the teachers. They volunteered to take part in changing what was known (their teaching practices) and at the same time offered their acts to be objects of analysis. In such cases the collaboration, building on trust and commitment, is put to the test and will easily break if roles, goals, and expectations are not known and agreed upon by all participants.

What we see in the studies we are involved in is that the collaboration and participants’ roles often change over the life of the project, which is not discussed in the literature mentioned above. The teachers participated in the research, in both teaching interventions and more systematic investigations of skills and ways of understanding numbers among the toddlers. That is, activities that were necessary for obtaining valid data from very young informants demand specific skills that traditionally belong to researchers’ pool of competencies. Thus, in the project, the preschool teachers’ pedagogical skills needed to be mixed with the skills of a researcher. The ambivalence in roles and expected competencies changed over the time of the project, with different skills needing to be foregrounded at different points. This demands a cognisance of the purpose of a certain activity, but also of what the individual teacher may contribute in competence to the common goals.

One typical example of this is the observation of a child not seeming to respond at all to the activity he or she is invited to participate in. From the researchers' perspective, this could be interpreted as a failure as the activity did not attract the intended attention to a certain learning object. The teachers, on the other hand, with their experiences of the children, reassured us that this was a common reaction to encountering a larger number range or unknown mathematical aspects. Some children responded hesitantly to all new encounters and needed to experience a new phenomenon several times before engaging wholeheartedly in an activity, which was a well-known behaviour to the teachers and did not indicate to them that the activity was inappropriately designed per se. Also, when a default in response observed by a teacher was raised as troublesome since the child acted in a non-typical way, a researcher-guided systematic observation of what the specific activity afforded this particular child the opportunity to discern (and not discern) brought to the fore new insights into how to further develop the teaching practices.

Conclusions

Collaboration is not an easy endeavour, as the story of the project used as an example in this chapter as well as so many other projects testify. But we choose to see the challenges we have faced as the greatest opportunity to reflect on our own preconceptions, expectations, and shortcomings. We have learnt many things from this, about educational practice, about implementing new ideas and changing old ones, about doing research, and not least about the necessity for different but complementary competencies for developing new knowledge that will make a difference for *both* educational science and early childhood education. Such a learning process takes time, and to our great fortune, we had the opportunity to use a longitudinal project design, which enabled us to explore the roles, expectations, and competencies we were working with. In this sense, we accomplished what Wagner (1997) described as a co-learning agreement: During the collaboration we changed the participating teachers' practices (teaching) and the researchers' ways of conducting their practices (research). But it is not yet known whether this will be sustained and develop further now that the collaboration has ended.

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