Early Childhood Teachers' Professional Competence in Mathematics

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Chapter 13

Outlook: Context and its consequences: A neglected factor in research on early childhood teachers' professional skills?

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Outlook: Context and its consequences

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Introduction

Who do we have in mind when we talk about early childhood teachers and their professional skills? And how is the professional field of work shaped for which they should acquire professional skills? These questions are all the more urgent because the job description of early childhood teachers does not relate to a standardized field, as is the case with teaching in school, for example. Despite considerable differences, models of professional knowledge of teachers are usually tailored to the context of schoolteachers and thus to a standardized field of work and action. The question is therefore whether common models can be transferred to the situation of early childhood teachers and, if so, to what extent they might be in need of adaptation.

Teaching—irrespective of a particular school level—is often, especially in the German-speaking research community, conceived of as an opportunity-usage structure ("Angebots-Nutzungs-Modell") (Figure 13.1) (Fend, 1998; Reusser & Pauli, 2010; Seidel, 2020).[1] This widely accepted modeling of teaching assumes that instruction has a social-interactive character and can therefore be interpreted as an interaction between the available opportunities to learn as provided by the teacher and their usage by the pupils. These opportunities to learn may differ in terms of goals, methods, or content. The basic assumption of such models is that an opportunity in itself is not sufficient to achieve learning success, but that an active use of the opportunities on the part of the learners is necessary to bring about an effect. Instruction is therefore fundamentally understood as an interconnected structure of teaching and learning processes.

The central task of the teacher in such a structure consists both in the planning, preparation, and provision of suitable opportunities to learn and in the active lending of learning support during the enactment of the lessons. In order to perform this task, teachers need planning and reflection skills as well as action-related skills (Lindmeier, 2011)[2] that are grounded in solid content knowledge (CK, here MCK), pedagogical content knowledge (PCK, here MPCK), and general pedagogical knowledge (GPK).

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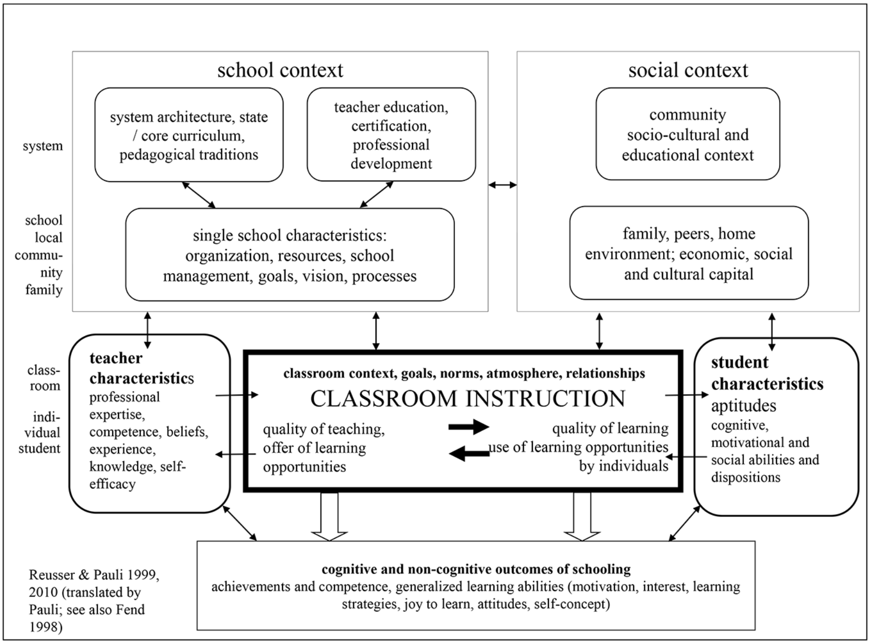

Figure 13.1 "Model of the provision and uptake of learning opportunities" (Reusser & Pauli, 2010, p. 18, translated by Reusser and Pauli, reprinted with kind permission of the authors).

The central interactants in this model of teaching and learning are the teacher on the one hand and the learners on the other hand. Their individual scope for active participation is defined by their cognitive and motivational-affective dispositions as well as by their situation-specific skills and prior knowledge. The restrictions and possibilities are not only related to the personal level, however (Figure 13.1). Rather, teaching with its interactants is embedded in various framework conditions and context variables—both on the side of the teachers and on the side of the learners—and limited by the societal framework as a space of possibility. What aspects of the subject matter are dealt with and negotiated in the interaction between the opportunity and its use in the classroom thus depends on cultural values, curricular guidelines, convictions, attitudes, and personal characteristics of the participants.

Cultural and societal influences determine pedagogical practice in a merely rudimentarily standardized field of work much more than in a highly standardized field of action. Educational activities in the field of early childhood are therefore much more diverse and strongly influenced by societal and cultural norms than one might think (e.g., Gasteiger, Brunner, & Chen, 2021; Hammer & He, 2016). Given this assumption, the question arises as to which postulates shape teaching in the field of early education and to what extent common models of professional knowledge and professional competence of teachers need to be adapted to the profession of early childhood teachers.

These questions are addressed in this contribution. First, it examines and discusses selected practices of early mathematics education with respect to their specificity. This leads to a characterization of the professional group that enacts these practices and to the question as to what skills are necessary for doing this in a competent and effective way. These reflections are summarized and discussed against the background of the model of transforming professional competence (Blömeke, Gustafsson, & Shavelson, 2015).

Early mathematics education

A rudimentarily standardized field

Teaching in schools, for example, mathematics instruction, is regulated by curricula and educational standards (e.g., Common Core State Standards Initiative, 2012; D-EDK, 2014; KMK, 2005; NCTM, 2000), by teaching aids such as visualizations and illustrative tools and models (e.g., Giaquinto, Mancosu, Jorgensen, & Pedersen, 2005), and by textbooks. The latter are the central instrument for introducing and presenting the range of tasks that needs to be completed, particularly in mathematics instruction (Rezat, 2013; Valverde, Bianchi, Wolfe, Schmidt, & Houang, 2002). They are based on the prescribed educational standards, which, in turn, are an expression of cultural and societal norms with respect to subject-specific contents and education and, moreover, must comply with the norms of the academic discipline (e.g., Burton, 2009).

Standardization of teaching means that it is possible to describe in relatively clear terms what skills and facets of competence teachers need to acquire and refine in order to be able to act competently within the opportunity-use structure of teaching (e.g., Brühwiler & Blatchford, 2011; Seidel, 2014). If, by contrast, there is no or merely rudimentary standardization of teaching, it is first necessary to determine what characteristics specify teaching in a particular societal context. Keeping to the example of early mathematics education, this prepares the ground for a precise determination of the professional skills of early childhood teachers.

Foundations of early mathematics education: two stances

On the one hand, early mathematics education is tailored to the developmental and psychological capabilities of young children (e.g., Sarama & Clements, 2009) and, on the other hand, builds on central objectives of kindergarten as an educational level (e.g., Clements, Sarama, & DiBiase, 2004). These objectives are mostly normative in nature and thus strongly dependent on the societal and cultural context, which, in turn, leads to different rationales for early mathematics education. In this regard, there are two main (normative) stances: (1)

kindergarten as a social-pedagogical institution with an educational mission and (2) the concept of "readiness for school" (Jegodtka, Hosoya, Szczesny, Jenßen, & Schmude, 2022). Countries such as Germany, the Netherlands, and Switzerland tend to follow the first principle, while the United States is more strongly oriented toward the second principle (Pohle, Jenßen, & Eilerts, 2022; Rimm-Kaufman & Sandilos, 2017). These different focuses on early mathematical education, which can also occur in hybrid forms and with varying weight, lead to different educational programs, implementations, and design elements and may thus also place different demands on early childhood teachers with respect to the requisite professional skills.

In the context of early mathematics education, the educational mediation between the opportunities and their use often oscillates between instruction and construction (Presmeg, 2014, p. 9). Quite often, there is a tendency to focus on construction and, at the same time, to be reluctant to give instructions (e.g., Björklund & Palmer, 2022), which corresponds to the first stance—kindergarten as a social-pedagogical institution with an educational mission. In countries such as the United States, where early mathematics education tends to follow the second stance "readiness for school", the principle of direct instruction is usually more explicit (De Haan, Elbers, & Leseman, 2014) and early childhood teachers interpret their work as consisting in direct teaching (Chiatovich & Stipek, 2016; Pohle et al., 2022). Depending on the orientation of the profile, early childhood teachers need to possess partly different professional skills.

Against this background, Chen, McCray, Adams, and Leow (2014) argue for a middle way. They call this "intentional teaching" and recommend an integration of both instruction and construction to ensure a high quality in early mathematics education.

Rationale I: central approaches and necessary skills

The first stance on early mathematics education is grounded in several age-specific approaches that make reference to child-centered approaches (OECD, 2011), such as play. Play is considered to be of great importance in developmental psychology (e.g., Piaget, 1975; Rubin & Pepler, 1982) as well as in early childhood education (e.g., Bruce, 1991; Ciolan, 2013). It therefore makes sense to use play also for the purpose of early mathematics learning (e.g., van Oers, 2010), for example, by including pedagogically suitable games (e.g., Stebler, Vogt, Wolf, Hauser, & Rechsteiner, 2013). In practice, such mathematics-related games have not yet become a regular part of pedagogical concepts, however, and their potential has not been fully recognized so far (Pohle et al., 2022).

A second approach of early mathematics education promotes learning in "natural" situations (Gasteiger, 2012). As in early mathematics learning through play, learning in natural and everyday contexts is highly situational and takes place in informal settings (Gasteiger & Benz, 2018a, 2018b). The teacher takes advantage of such situations and enriches them by emphasizing the mathematical aspects and linking them to the children's previous experiences and their prior (informal) knowledge. This provides children with the opportunity to acquire mathematical knowledge although there is no explicit or only little scaffolding (Collins, Brown, & Newman, 1989).

A third approach of early mathematics education follows a more formal approach and suggests learning with and from stories and picture books (Ginsburg, 2022, in this volume), which is characterized by a higher degree of instruction-like and -guided teaching. The teacher can either make use of the (implicit) mathematical content in an already existing story (e.g., van den Boogaard, van den Heuvel-Panhuizen, & Scherer, 2007) or refer to a picture book that was explicitly designed for the conveying of mathematical contents (e.g., Björklund & Palmer, 2022).

Due to the often highly spontaneous nature of such activities and the need to recognize, challenge, and support mathematically rich activities "on the spot", the focus of research into this field is particularly directed toward the situational skills of early childhood teachers. These skills do not develop exclusively on the basis of cognitive and affective-motivational dispositions (Blömeke et al., 2015), however, but also rest on both explicit and implicit knowledge (Gasteiger & Benz, 2018a, 2018b), incorporate experience and relate to pedagogical action (Lindmeier, 2011).

Recognizing the mathematical content in play situations requires, in particular, appropriate CK. Several recent studies (Bruns, Gasteiger & Strahl, 2021; Bruns, Strahl, & Gasteiger, 2020) indicate that common models of professional competence seem to underestimate the importance of implicit and practical knowledge as a contribution to competent action. Bruns et al. (2021) therefore operationalize mathematics-related knowledge of early childhood educators as a continuum between the poles of theory/science and practice and distinguish between concepts of MCK that are markedly oriented toward the academic discipline ("science-related") and concepts of MCK that refer to immediate practice ("practice-related"). Since mathematical expertise influences MPCK as well as the ability of early childhood teachers to perceive situations that are potentially conducive to learning (e.g., Dunekacke, Jenßen, Eilerts, & Blömeke, 2016), it is important to ask what kind of mathematical expertise this exactly is and which components can be deemed particularly important with regard to professional skills.

As illustrated by the picture-book approach (van den Heuvel-Panhuizen & van den Boogaard, 2008), play or opportunities to learn in natural situations are not always informal or incidental, but can be planned, prepared, and intentionally stimulated, analogous to school-based learning. Such approaches, which do not necessitate immediate action under pressure (Wahl, 1991), require not only situation-specific skills but also reflection skills (Lindmeier, 2011), and rest on explicit knowledge that is possibly combined with implicit knowledge. It would therefore be worth investigating more closely the extent to which implicit knowledge is used in the transformation of professional competence into performance and under what circumstances lesson preparation can combine implicit knowledge with explicit knowledge so as to ensure successful adaptive pedagogical action.

Rationale II: central approaches and necessary skills

If, by contrast, early mathematics education is primarily conceived of as “readiness for school”, the contents are also based on normative principles, but these relate to educational standards of the next education level and the preparation for their achievement rather than social-pedagogical development. This is why content-related pre-concepts, for example, in the area of counting or quantity awareness (e.g., Krajewski & Schneider, 2009), which are often imparted and dealt with by means of learning programs (e.g., Krajewski, Nieding, & Schneider, 2007) or teaching materials that have specifically been designed for the purpose of early learning (e.g., Wittmann & Müller, 2010), have received increased attention in recent years.

In comparison to the approaches that are characteristic of the first stance, this explicit orientation toward school standards also leads to a higher degree of standardization of early education. The concept of “readiness for school” focuses on school-like learning, ensures the provision of preparatory activities, anticipates follow-up activities, and transfers existing school-based educational standards to the area of early education. According to this rationale, the professional field of early childhood teachers comparable to that of teachers in general.

Teaching in accordance with Stance II requires early childhood teachers to base their practice explicitly on MCK and MPCK. In combination with reflection skills (Lindmeier, 2011), this subject-specific knowledge allows them to plan and enact their lessons in a way that is conducive to the children’s acquisition of elementary mathematical concepts. Several models have refined the concept of MPCK by splitting it up into components such as explanatory knowledge, diagnostic knowledge in the sense of knowledge about the mathematical thinking of learners, and knowledge about mathematical problems (Baumert & Kunter, 2013). Knowledge about mathematical problems is particularly relevant in school teaching where task completion is the central formative element of mathematics education (Rezat, 2013; Valverde et al., 2002). With regard to professional skills of early mathematics education, Sarama, Clements, and Stark Guss (2022, p. 164) suggest the three skills, “understanding the goals”, “understanding children’s thinking and learning”, and “understanding effective teaching”. These skills relate to different and multiple areas of knowledge (Shulman, 1986) and do not exclusively refer to MPCK, however. Analogous to the model proposed by Baumert and Kunter (2013), knowledge about specific age-appropriate learning settings and learning opportunities could be added as a further component of professional competence.

Framework and general conditions of teaching

Which of the two stances dominates in early mathematics education in a given country depends on the cultural and societal context. This context not only encompasses the educational settings but also the children since they are "part of their culture and the context created by their culture" so that "they will engage in mathematical thinking that is generated from these" (Cooke & Jay, 2022, p. 143). This assumption is of special significance in the area of early childhood education because, as set forth in Section 2.1, there is a lack of standardization of content or subject matter at this educational level, which is why factors that relate to cultural influences are receiving increasingly more attention in research (Gasteiger et al., 2021; Hammer & He, 2016; Oberhuemer, 2005).

If early mathematics education is not regarded as a standardized field and the teaching practices in a country are shaped by its cultural values and norms, it cannot be assumed that early mathematics education requires teachers to possess the same professional skills or even the same facets of these skills across all national contexts. In other words, it seems likely that professional contexts in which early childhood teachers work may vary considerably. In order to illustrate this conclusion, the following section presents the framework conditions of early mathematical education in the countries in which the authors of this volume are active as examples.

Early childhood teachers: who are they?

A special group of teachers

Due to the lack of or only rudimentary standardization of the educational level and their training, which is considerably influenced by the cultural and societal context, it seems plausible to assume that the profile of early childhood teachers as a professional group varies remarkably across countries (Gasteiger et al., 2021). Moreover, they can also be assumed to differ significantly from schoolteachers in terms of personal characteristics, for example, in their relationship to the subject of mathematics, for which there is no curriculum in various countries (Table 13.1).

Early childhood teachers often appear to be "math-avoidant" teachers, especially since anxiety about mathematics has been shown to be "a factor in the career choice of prospective early childhood teachers" (Jenßen, 2022, p. 90). Interest in mathematics, by contrast, does not seem to be a determining factor in the decision to take up the profession, especially when early childhood teachers are trained as generalists (Jenßen, 2022). Although their emotions about mathematics are not as negative as they are often supposed and reported to be (Chen, McCray, Adams, & Leow, 2014), and negative emotions are not as strong as commonly suspected, there is no doubt that a teacher's emotions about mathematics matter and that negative emotions such as anxiety about mathematics are widespread (e.g., Thiel & Jenßen, 2018). This is problematic because

Table 13.1 Overview of framework conditions of early childhood education in selected countries

	USA	*Australia*	*Germany*	*Austria*	*Switzerland (German-speaking part)*	*Belgium (Flanders)*	*Norway*	*Sweden*
Age of children	3–6 years	4–5 years	3–6 years	3–6 years (pre-school/ kindergarten) 0–3 nursery	4.5–6.5 years	2.5–6 years	1–5 years	1–6 years
Compulsory for children	Not compulsory, but most children attend	Not compulsory	Not compulsory	Last year of preschool/ kindergarten is compulsory	Yes	Not compulsory, but 97% attend	Not compulsory, but 92% of the 1- to 5-year olds and 97% of the 3- to 5-year olds attend	Not compulsory, for 6-year olds compulsory
Part of official education system	Kindergarten yes and sometimes pre-K (4's)	Yes, in Western Australia (this differs in other states)	No	No	Yes	Yes	Not part of the education system, but it is usually considered to be a part of the education system, even though it is not compulsory	Yes

(Continued)

Table 13.1 (Continued)

	USA	*Australia*	*Germany*	*Austria*	*Switzerland (German-speaking part)*	*Belgium (Flanders)*	*Norway*	*Sweden*
Responsibility to run ECE	Varies	Government, but church-based schools also offer ECE classes	State for a number of structural aspects (e.g., child-teacher ratio); care providers (e.g., community, church, welfare association) for pedagogical aspects (additional "Bildungspläne" from the federal states)	Federal states of Austria (e.g., federal state of Styria, federal state of Carinthia, etc.) are responsible for legislation and implementation, ECE maintained by municipalities, regional or private providers, and church	State and municipality share responsibility	Flemish government decides on the curricular objectives and educational laws	State and municipality share responsibility	N.A.

(Continued)

	USA	*Australia*	*Germany*	*Austria*	*Switzerland (German-speaking part)*	*Belgium (Flanders)*	*Norway*	*Sweden*
Kind of initial education	BA, when part of official school system	4 years, university-trained teacher	Majority graduates from vocational schools; only a few university graduates (BA child pedagogy or other BA)	Diploma, 5-year upper-secondary school with vocational education (teacher training colleges for early childhood education—BafEPs) or four-semester post-secondary or five-/six-semester part-time vocational education and training courses at the teacher training college for early childhood education	BA, university of teacher education	BA, non-academic teacher training institute	BA, university, or university college	BA university degree, vocational degree
Job designation	Varies, depending on placement	EC teacher	Erzieher*in (“educator”)	Kindergarten teacher	Kindergarten teacher	Kindergarten teacher	Kindergarten teacher	Preschool teacher

(Continued)

Table 13.1 (Continued)

	USA	*Australia*	*Germany*	*Austria*	*Switzerland (German-speaking part)*	*Belgium (Flanders)*	*Norway*	*Sweden*
Generalist—subject-specific	Generalist	Generalist	Generalist	Generalist	Generalist	Generalist	Generalist	Generalist
MPCK, MCK part of curriculum of initial education	Yes, but slightly	Yes	Depends on the federal state and the institution where the education took place	No	Yes	MPCK generally is, MCK usually not—but teacher training institutes are free to decide for themselves on the curriculum they offer	Yes	Yes
Mandatory mathematics curriculum for ECE	No	Yes, for the compulsory years	No; most “Bildungspläne” include mathematics-related aspects	No	Yes	No	Yes	Yes, but no prescribed achievement goals (only to strive toward)
Literacy-based or inner-mathematical	Literacy-based	Balanced	Depends on the respective “Bildungsplan”	–	Literacy-based	N.A.	Literacy-based	N.A.

(Continued)

	USA	*Australia*	*Germany*	*Austria*	*Switzerland (German-speaking part)*	*Belgium (Flanders)*	*Norway*	*Sweden*
Parents' estimation, expectations	Play-based learning—some math, mostly social-emotional	N.A.	Depends on several aspects, groups of parents would deem it necessary, especially in the last year before school begins	Play-based learning activities	Focus on play, social development, less on subject-specific learning	Play-based learning activities	Two opposing fractions: the majority focus on play and social pedagogy and many of them look at early mathematics education with trepidation, but a growing group sees its importance and wants a stronger focus on learning activities	N.A.

enthusiasm for mathematics is related to enthusiasm for fostering mathematical skills in children (Vogt et al., 2022), which, in turn, influences the way in which a teacher designs learning environments. Although emotions are largely individual in nature, positive emotions about mathematics seem to be trainable, however, if the preparation program combines practical and theoretical training units (Thiel, 2022).

That early childhood teachers are often anxious about mathematics and tend to have little interest in the subject may lead to further consequences because this can also affect other areas of knowledge, especially MPCK. The influence of MCK on MPCK is controversially debated and some researchers judge it to be limited (Bruns et al., 2021), which could be put down to the fact, however, that in many studies the underlying conception of MCK was science-oriented rather than practice-oriented. This implies that the conceptualization of specialized knowledge as it was developed for school-related fields of work may not be easily transferable but needs other operationalizations with a practical orientation that also take the application of implicit knowledge into account and include situation-specific aspects (e.g., Gasteiger, Bruns, Benz, Brunner, & Sprenger, 2020; Torbeyns, Demedts, & Depaepe, 2022).

This distinction between science-related and practice-related facets of MCK (Bruns et al., 2021) could serve as a useful starting point for further research. For example, it would be worth examining whether anxiety about mathematics of early childhood teachers (e.g., Jenßen, 2022) or their emotions about mathematics (Thiel, 2022) could be explained by the assumption that their notion of mathematics commonly relates to the academic discipline while they do not see the immediate practical relevance of mathematics in everyday life. Furthermore, research into such questions should not neglect that the cultural and societal context shapes the image and thus individual notions of mathematics as well (Blömeke, Hsieh, Kaiser, & Schmidt, 2014; Dunekacke et al., 2016).

Job titles and general conditions

Are early childhood teachers primarily educators or are they rather like schoolteachers? A glance at the articles in this volume reveals a wide variety of job titles: they are called “early education teacher”, “early childhood teacher”, “early childhood education and care teacher”, “early childhood educator”, “preschool teacher”, “kindergarten educator”, or “kindergarten teacher”. They work in “kindergarten”, in “preschool”, in “early childhood education and care”, or in “early childhood education and care institutions”. In view of this variety of terms for designation and workplace, it remains unclear whether all of them refer to comparable fields of work and professions. Without clarification of this fundamental terminological question, it is not possible to define a profile of professional skills and knowledge that is intended to cover the duties and activities of a supposedly homogenous professional group.

The results of a written survey of the authors who contributed to this volume can shed some light on this question, at least as far as their countries are concerned (Table 13.1). The selection of the framework conditions was based on the study by Gasteiger et al. (2021).

This limited selection of countries already suffices to show the wide diversity of central framework conditions (Table 13.1). Whether kindergarten attendance is compulsory for children (e.g., Switzerland) or optional (e.g., USA, Belgium) is likely to have a significant impact on the education of early childhood teachers and thus on their professional skills. The same applies to the age of the children and to whether there is a compulsory curriculum for early mathematics education. Furthermore, in some countries such as Australia or Germany, there are also marked regional differences in terms of general conditions, education, and kindergarten management that point to the heterogeneity within this only apparently homogenous professional group.

Education and professional development of early childhood teachers

As Table 13.1 indicates, there are also considerable differences with respect to the training of early childhood teachers. While some acquire a bachelor's degree, others complete their basic education at a vocational school. The structure and the academic level of the training, in turn, may lead to different expectations regarding performance (e.g., Rettenbacher, Eichen, Pfiffner, & Walter-Laager, 2022). The majority of early childhood teachers in all of the countries are trained as generalists. Whether and to what extent they acquire mathematics-specific content knowledge and pedagogical skills during their education varies greatly. As regards those training programs that explicitly include topics relating to mathematics, it would be worth investigating whether their conception of MCK is scientific or practical (Bruns et al., 2021).

According to the principle of life-long learning, professional skills are not only built up during the initial phase of training but constantly need to be developed throughout the professional career. For this reason, opportunities for further and continuing education that allow practicing early childhood teacher to expand and refine their professional skills are also important with respect to their qualification (Torbeyns et al., 2022, in this volume). This is reflected in the wide variety of concepts for professional development strategies, activities, and tools that are currently available (e.g., Gasteiger & Benz, 2018b; Sarama et al., 2022) and have proven to have positive effects on the early childhood teachers' skills (Bruns, Eichen, & Gasteiger, 2017; Gasteiger & Benz, 2018b; Sarama et al., 2022). The model of professional development along learning trajectories proposed by Sarama et al. (2022) as an example of such a program or course addresses different skills concerning understanding: understanding of goals, of children's thinking, and of effective teaching. In contrast, Gasteiger and Benz (2018b, pp. 13–14) devised a three-phase model for continuing education that addresses not only different skills but focuses on different “components of knowledge” depending on the phase. In Phase 1, explicit knowledge is at the center, and which can be taught. Phase 2 consists in “exploring mathematics in join-in studio” and focuses on “situational observing and perceiving” and pedagogical action, which is tested and practiced, and which focuses on gaining experience. This phase also pays attention to implicit knowledge. The final phase, Phase 3, is designed as a reflection meeting that reviews and evaluates the entire learning and training process.

That the focus on different areas of knowledge could be useful to foster the early childhood teachers’ skills and may vary depending on the stage of the career can also be inferred from the results of the study by Dunekacke & Blömeke (2022). What contents and which knowledge components the training unit or professional-development activity should center on depends on the participants’ prior knowledge and is thus likewise subject to cultural and societal framework conditions that structure and limit the education of early childhood teachers.

Conclusion

Do the foregoing sections provide a basis for answering the question concerning the professional skills that early childhood teachers need to be able to act competently? And can the answer take a general form when both the field of work and the training of early childhood teachers at least partly depend on cultural and societal norms and vary across countries and sometimes even within a country?

It is undisputed that early childhood teachers need explicit professional knowledge (Gasteiger & Benz, 2018a, 2018b). In the model proposed by Blömeke et al. (2015), professional knowledge is summarized, complemented by motivational-affective components and incorporated into the domain of dispositions. Other types of knowledge such as “interaction knowledge” or “counseling knowledge” (Baumert & Kunter, 2013) are considered to be relevant as well. Lindmeier (2011) subsumes these components under the basic skills and personal characteristics that are requisite for professional action. Depending on the research question, it makes sense, however, to subdivide professional knowledge into different areas of declarative knowledge (Anderson & Krathwohl, 2001; Dunekacke & Blömeke, 2022)—in the large three areas GPK, MCK, MPCK (Shulman, 1986) or in their further defined components (e.g., Ball, Thames, & Phelps, 2008) or in individual facets—and to operationalize them specifically for the field of work to which they apply. Explicit professional knowledge should be linked to implicit knowledge (Gasteiger & Benz, 2018a) and to appropriate experiences, as we see in models of teacher education and professional development (e.g., Gasteiger & Benz, 2018a; Sarama et al., 2022).

The model of transformation of professional competence (Blömeke et al., 2015), which structures this volume, does not primarily describe the individual areas of professional competence but rather the process of transforming professional knowledge areas, facets and dispositions into visible action in the professional field in the sense of performance. Lindmeier (2011) speaks in her three-component model of “action-related competencies”, which develop alongside reflection skills on the basis of “basic knowledge”. Planning and preparatory activities require reflection skills while action-related skills are needed in the enactment of the lesson and during the immediate pedagogical action in the situation. Dunekacke and Blömeke (2022, p. 121) understand the planning of mathematics-related actions (“ACT”) as a “situation-specific skill”, while Lindmeier (2011) considers preparatory planning to form part of a teacher’s “reflective competence” and interprets immediate action in the situation of teaching as “action-related competence”. Depending on the type of planning, in the situation or in advance, one or the other perspective might prove to be more adequate.

In the model by Blömeke et al. (2015), these action-related skills are interpreted as “situation-specific skills” and further subdivided into “perception”, “interpretation”, and “decision-making”. In their entirety, these components lead to “performance” that manifests itself in observable behavior. In this model, “perception” (“PERC” in Dunekacke & Blömeke, 2022), which depends on professional knowledge, is of particular importance to the connection with situation-specific skills (e.g., Bruns et al., 2020; Dunekacke, 2016).

Do early childhood teachers in the field of early mathematics education therefore merely need—as suggested by the model by Blömeke et al. (2015)—appropriate dispositions and situation-specific skills? As mentioned, the field of work of early childhood teachers seems to differ significantly from that of schoolteachers in various respects and across national contexts. This leads to the question as to whether it is sufficient to model the requisite professional skills of early childhood teachers in accordance with common models. The model proposed by Gasteiger and Benz (2018a), which distinguishes between “explicit knowledge” and “implicit knowledge” and emphasizes individual diagnostic skills and the ability to support learning processes, at least suggests that models that only include the level of explicit knowledge might not suffice to capture the professional skills of early childhood teachers in an adequate way.

One open question that is in need of clarification concerns the process of the generation of visible performance in practice and the importance of different areas of knowledge in the modeling of professional action. In which of them is situation-related action grounded, both in prepared situations and immediately in the situation under time pressure? Furthermore, it needs to be clarified what role procedural knowledge plays in this transformation process and to what extent this component of explicit knowledge is accessible to early childhood teachers. Finally, it should be considered whether the model of transforming professional competence (Blömeke et al., 2015) could be extended by a fourth phase that consists in the monitoring or at least in the evaluation of one’s professional actions as in the model of Gasteiger and Benz (2018a, 2018b).

This suggestion builds on the assumption that the ability to review, evaluate, and reflect on one's own performance in a specific pedagogical situation is indispensable with respect to effective professional development, on the one hand in the sense of the figure of the reflected practitioner (Schön, 1983) and on the other hand as an expression of professionalism. Such an extension would imply the necessity of enriching existing models by the aspect of professional self-regulation, which Baumert and Kunter (2013) regard as one of four aspects (convictions/values/goals, motivational orientation, self-regulation, and professional knowledge) of professional competence.

For the purpose of devising an all-including, holistic model that is explicitly tailored to early childhood teachers, the model of the transformation of professional competence by Blömeke et al. (2015) could therefore be combined with models of professional competence that have been specifically developed for this professional group (Gasteiger & Benz, 2018a, 2018b) and with models of basic professional knowledge components such as the one proposed by Lindmeier (2011) (Figure 13.2). Such a conceptual synthesis would take the different types of knowledge into account that are used in different ways in the individual phases of the transformation process of professional skills in more detail.

Both dispositions and situation-specific skills can be discussed against the background of explicit and implicit knowledge. Dispositions correspond to the concept of basic knowledge as proposed by Lindmeier (2011) (adapted for primary school teachers' knowledge by Knievel), which contains both explicit

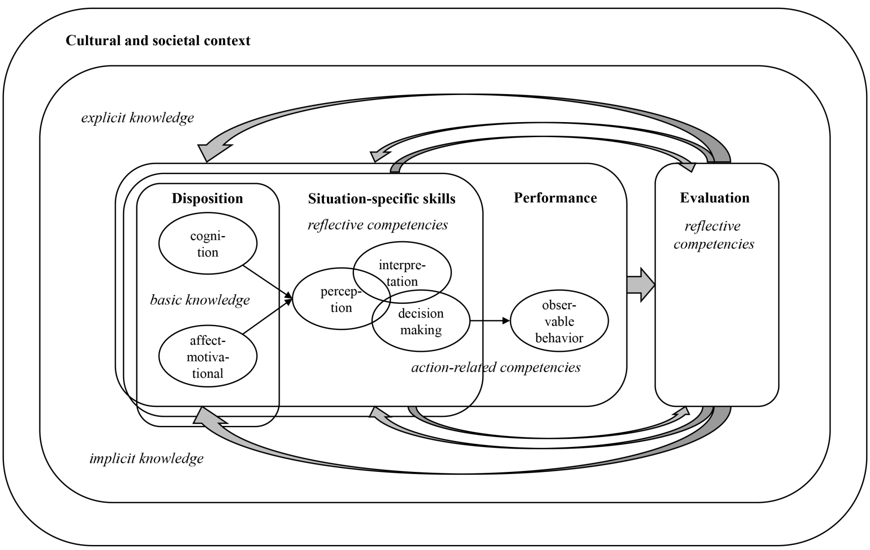

Figure 13.2 Conceptual synthesis for modeling the transformation of professional skills of early childhood teachers (based on Blömeke et al., 2015; Gasteiger & Benz, 2018a; Lindmeier, 2011).

and implicit components. Explicit as well as implicit knowledge is also included in situation-specific skills. Reflection skills are required when early childhood teachers plan a concrete teaching situation. Moreover, these skills are also relevant when, in connection with situation-specific skills, the action and/or the decision-making process are preceded by a brief evaluation. This would manifest itself in a minimal pause between perception and interpretation on the one hand and decision making on the other hand. The faster the decision making follows, the more likely it is that an early childhood teacher builds on implicit knowledge. Situation-specific skills are only transformed into performance and observable behavior, however, if action-related skills—also fed by implicit and explicit knowledge—are available and applied.

Although models that are specifically tailored to the professional profile of early childhood teachers could contribute to an improved understanding of teaching practices in this field, it should not be forgotten that both explicit and implicit knowledge are highly dependent on cultural and societal framework conditions and relate to a comparatively little standardized and regulated field of work. Therefore, it would be important to include central contextual factors systematically in future research on professional skills of early childhood teachers and to take them into account when interpreting the results. If the situation and the context of early childhood teachers' professional field of work differ from each other in terms of cultural patterns and influences, then context should be given increased attention—in research, in practice, and in the international discourse. Only an elucidation of the contextual factors allows an adequate interpretation of research findings. In order to examine the role and influences of the context, more cross-cultural studies are needed that compare the professional knowledge of early childhood teachers, the development of the children's performance, or the teaching practice in a detailed way. It is in this respect too that volumes that bring together comparative studies or studies from different countries and provide a solid basis for discussion are indispensable.

Notes

1 Occasionally, these models have also been referred to in the English-speaking discourse (e.g., Brühwiler & Blatchford, 2011).
2 The original model proposed by Lindmeier (2011) has been adapted to the professional competences of elementary mathematics teachers by Knievel, Lindmeier, and Heinze (2015) and to early childhood educators by Lindmeier et al. (2020).

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