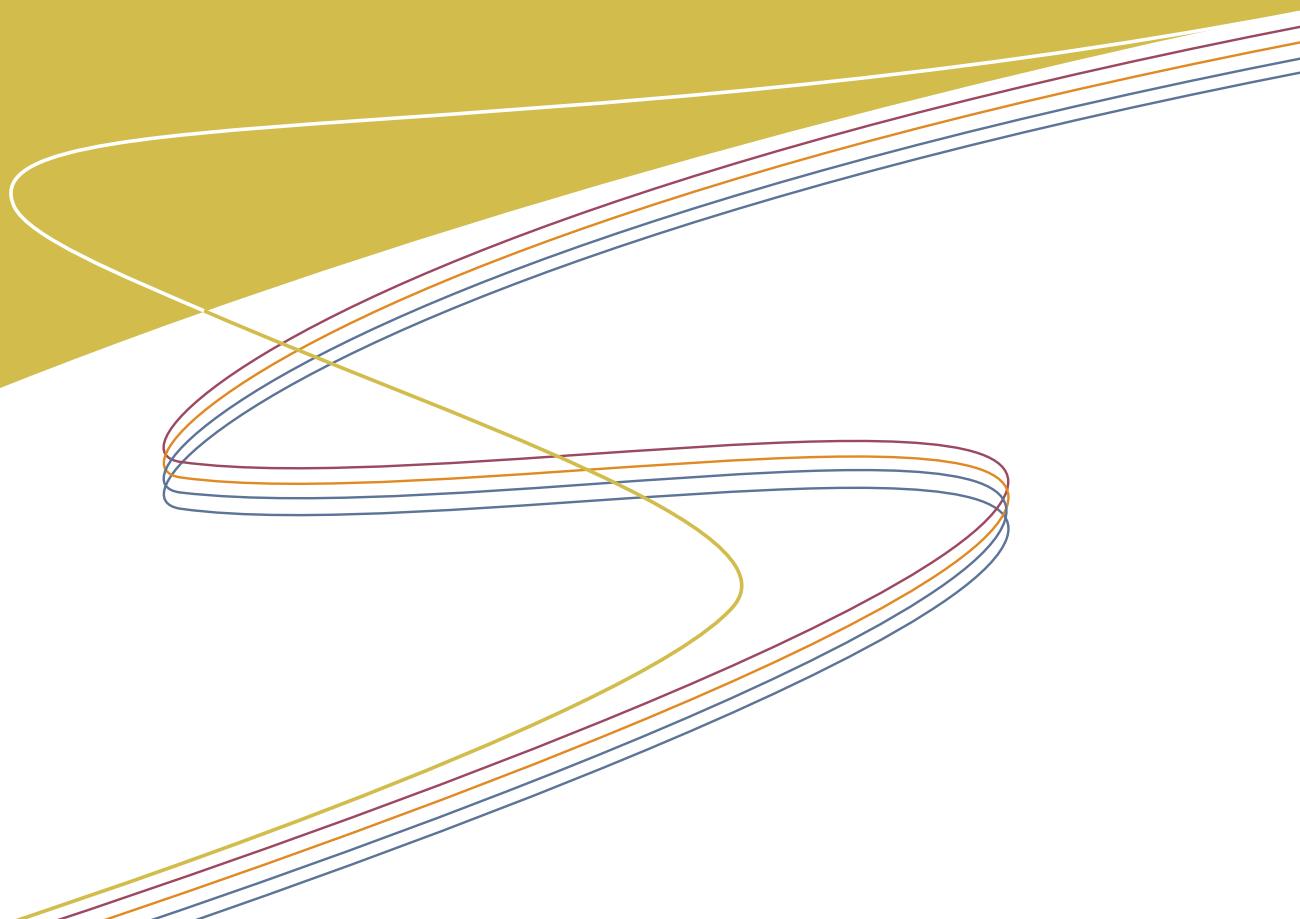
RESEARCH LINE 1

EDUCATIONAL PROCESSES IN PRESCHOOL EDUCATION



EDUCATIONAL PROCESSES IN PRESCHOOL EDUCATION

Schmerse, D., Anders, Y., Flöter, M., Wieduwilt, N., Roßbach, H.-G., & Tietze, W. (2018). Differential effects of home and preschool learning environments on early language development. *British Educational Research Journal, 44*(2), 338–357.

There is a broad consensus that the early years are particularly important for the development of basic cognitive and socio-emotional skills which support children in mastering everyday requirements later on. In addition to these general skills there is a strong interest in the development of cognitive skills in domains such as language, mathematics, and science which predict academic achievement in primary school. High levels of academic skills in these domains are in turn prerequisites for highly qualified professional activities and participation in modern society. The development and support of early cognitive skills is therefore of major interest for science and society.

Research Line 1 focusses on the development of pre-school skills in the three domains mathematics, science, and language. Language is a central prerequisite for the development of mathematical and scientific literacy, enabling individuals to communicate about and reason regarding mathematical and scientific issues. Specifically, we focus on the interplay of individual resources and quality of home and institutional learning opportunities. Evidence-based knowledge about factors influencing the development of basic skills is highly relevant to implement appropriate and effective early domain-specific educational processes. Educational quality is commonly defined by the structural and process characteristics that are thought to nurture child development. Process quality refers to the child's day-to-day experiences in home and early childhood education and care (ECEC) settings and encompasses the social, emotional, and instructional aspects of children's activities and interactions with families, teachers, peers, and materials. These activities and interactions are seen as proximal determinants of child development. Structural characteristics, such as group size, children-to-teacher ratio, or socioeconomic status influences process quality and thus have an indirect influence on the development of children (see Figure 1). Besides structural characteristics, professional competence of teachers in ECEC and parental competences are regarded as crucial for the implementation of educational processes of high quality (see Figure 1). At the same time there are only few findings on the development and support of especially domain-specific professional competences and their effects on child development.

RESPONSIBLE FOR RESEARCH LINE 1:
Mirjam Steffensky (spokesperson), Anke Lindmeier & Olaf Köller

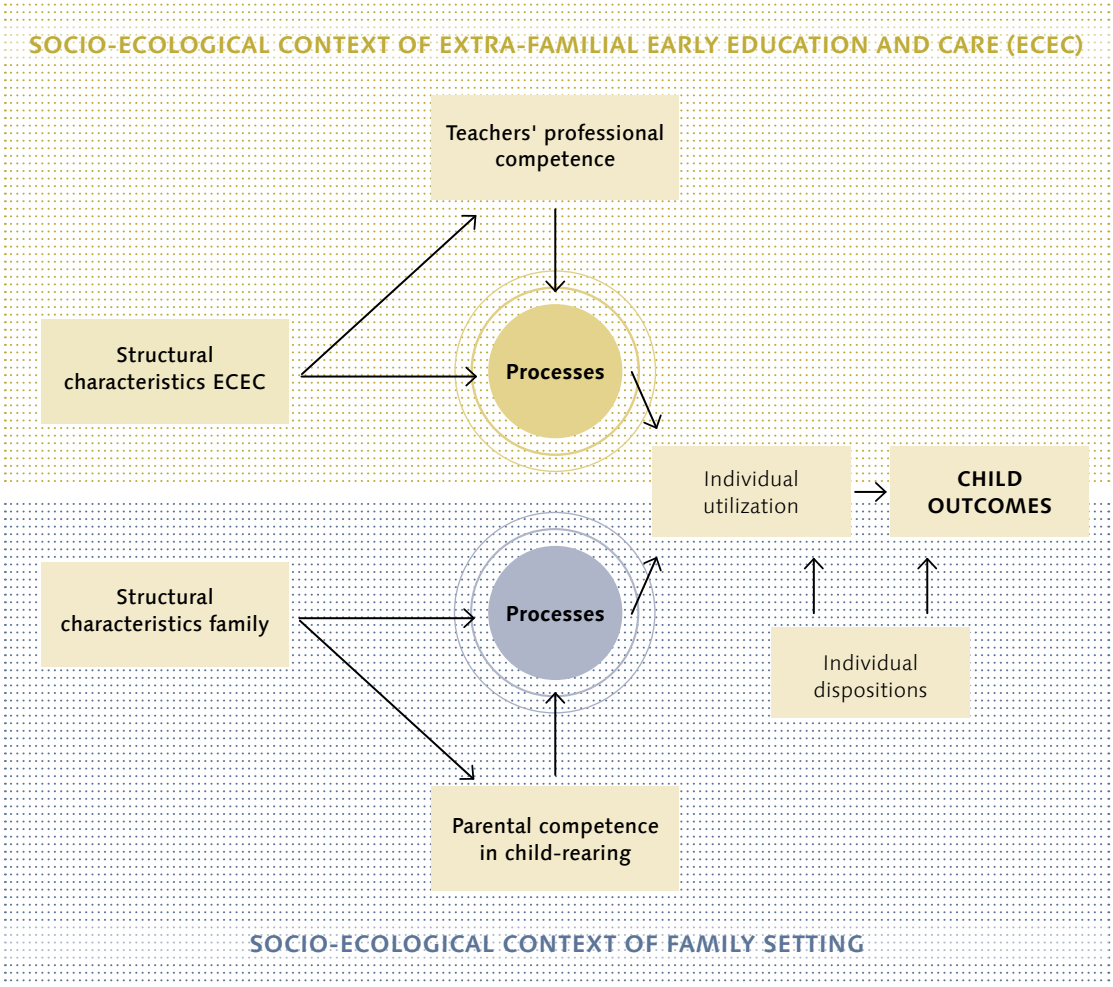


Figure 1. Bioecological model on child development in familial and extra-familial settings of early childhood education and care.

In light of the need of research in this area, Research Line 1 focusses on

1. Individual resources and characteristics of home and institutional learning environments and the extent to which they influence development of children aged 0–6
2. Development, support, and effects of domain-specific professional competence of teachers in ECEC

In the following, we provide a brief overview on the activities in Research Line 1. In Section 2 and 3 specific findings of NEPS (National Educational Panel Study) and WILMA (We learn mathematics) will be presented in more detail.

1 Central activities in the period of reporting

(a) Bremen Initiative to Foster Early Childhood Development (BRISE)

Bremen Initiative
to Foster
Early Childhood Development

The Bremen Initiative to Foster Early Childhood Development (BRISE) is a longitudinal quasi-experimental study that systematically investigates the effects of early childhood interventions with a special focus on children from low socio economic status (SES) and immigrant families. Bremen has a diverse range of co-existing early childhood and pre-school programs. These programs for children from socially and culturally disadvantaged families aim to prevent future disparities in general as well as in domain-specific cognitive and social skills. The insights gained in Bremen will inform policy on early childhood and be constructive in providing equal opportunities for all children, protecting children, and promoting their development and participation in society. BRISE is the first longitudinal study to investigate the effects of a program fostering early childhood development that is broadly implemented within a specified region. BRISE systematically links early childhood and preschool programs into a chain of interventions. The programs forming that chain—home-based as well as center-based interventions—are all integrated into everyday life and most of them are already established in Bremen. The intervention begins in the prenatal period and ends after the children start elementary school. The program started in 2016, is funded by the Federal Ministry of Education and Research (BMBF), the Jacobs Foundation and the Free Hanseatic City of Bremen; a subsequent 4-year grant period is planned. The global research question is whether linking existing programs—home-based as well as center-based programs that are integrated into everyday life and have proven effective—positively impacts cognitive, social and emotional development of children from disadvantaged families. An interdisciplinary research team with researchers from several Leibniz institutes and universities is conducting the study due to the complexity of the project. Disciplines involved include developmental, educational and cognitive psychology, early childhood education, science and mathematics education, and economics of education. The IPN and the University of Bremen are leading and coordinating the research program. Families participating in the intervention chain will be compared with families who decide for themselves in which and in how many of Bremen's programs they enroll. Linking BRISE to the German Socio-Economic Panel (SOEP) as well as to the National Educational Panel Study (NEPS) further enables comparative analyses with additional high-quality data.

(b) Research on the assessment and support of domain-specific professional competence

Preschool teachers' domain-specific professional knowledge is assumed to play an important role in the quality of early childhood education and thus in young children's learning. Little is known about preschool teachers' mathematics and science-specific knowledge and its effects due to a lack of adequate instruments. Therefore, in two projects instruments were developed for assessing facets of professional knowledge in the domain of mathematics ("Structure of early childhood educators' domain-specific professional competences and their effects on the quality of mathematical instructional situations in kindergarten and on children's increase in mathematical competences" (WILMA)), for more details see Section 3, and science ("Early steps into science" (EASI S)). First results from EASI S regarding the structure of preschool teachers' science-specific knowledge for example show that preschool teachers' content knowledge (CK) of concepts, CK about inquiry and their pedagogical content knowledge (PCK) are empirically separable but highly correlated. Moreover, we found a weak positive relation between preschool teachers' professional development courses in science in the last year and their CK about concepts but no relation to CK about inquiry and PCK. This might be caused by the low amount of preschool teachers' participation in professional development courses in science (on average less than one course in the last year) and by the low intensity of such one-day courses. Moreover, usually these courses have a focus on teaching CK about concepts, but topics such as scientific inquiry or children's cognitions (i. e., PCK) are not addressed.

Barenthien, J., Lindner, M. A., Ziegler, T., & Steffensky, M. (2018). Exploring preschool teachers' science-specific knowledge. *Early Years*. Advance online publication.

c) Leibniz Center of Excellence for Early Childhood Education

The Leibniz Center of Excellence for Early Childhood Education (EARLYEd) was established in the beginning of 2017. EARLYEd is an interdisciplinary research cooperation with scientists from the fields of educational psychology, developmental psychology, educational research, cognitive psychology, science and math education, as well as economics of education. Different universities and Leibniz institutes participate in the center which is coordinated by the IPN. EARLYEd researches the general and domain-specific developmental of children during the first eight years of life and the interplay with family and institutional learning environments. The research program also addresses questions concerning general and domain-specific professional competence of ECEC teachers.
A grant proposal has recently been submitted to the German Research Foundation (DFG) as part of EARLYEd. The 12 included project proposals address children's development in mathematics, science, and language as

LEIBNIZ CENTER OF EXCELLENCE FOR
Early Childhood Education

EARLYEd members:

- IPN Leibniz Institute for Science and Mathematics Education
- DIPF – The German Institute for International Educational Research
- Otto-Friedrich-University Bamberg
- Goethe University Frankfurt/Main
- IWM – Leibniz-Institut für Wissensmedien, Tübingen
- Freie Universität Berlin
- LIfBi – Leibniz Institute for Educational Trajectories
- DIW – German Institute for Economic Research

Meudt S.-I., Souvignier, E., Hardy, I., Labudde, P., Leuchter, M., Steffensky, M. & Möller K. (2017). Förderung stufenübergreifender Bildungsprozesse: Evaluation eines curriculumbasierten Kooperationsprogramms. [Fostering learning processes from preschool onwards up to the secondary school. Evaluation of a curriculum-based project]. *Zeitschrift für Grundschulforschung, 10*(1), 76–90.

Hardy, I., Steffensky, M., Leuchter, M., & Saalbach, H. (2017). *Spiralcurriculum Schwimmen und Sinken: Naturwissenschaftlich arbeiten und denken lernen.* [Spiral Curriculum Floating and Sinking. Scientific thinking and working in kindergarten]. Seelze: Friedrich Verlag Band 1: Elementarbereich. Bonn: Deutsche Telekom Stiftung.

Steffensky, M. (2017). *Naturwissenschaftliche Bildung in Kindertagesstätten [Early science education]. (Weiterbildungsinitiative Frühpädagogische Fachkräfte, WiFF Expertisen; Vol. 48). München: Deutsches Jugend Institut.*

well as the influence of instructional and emotional support children receive within institutions of ECEC. Furthermore, they focus on the impact of preservice training and professional development on ECEC teachers' professional competence, the quality of learning opportunities and children's outcomes.

(d) From research to pedagogical practice

Following the IPN mission, Research Line 1 is engaged in transferring findings from science into pedagogical practice. For several years a team in the project MINTeinander, from the field of science education and early education has been working on the development and implementation of spiral curricula to foster scientific competences of students from ECEC up to the secondary level. In the project MINTeinander the IPN in cooperation with others is responsible for the development of learning environments for children aged 4–6 and the professional development of ECEC teachers. One main aim of the project is the support of domain-specific cooperation between the different institutions. In 2017 new teaching materials were published on the topic floating and sinking and a professional development course for multipliers of the curriculum was implemented. Furthermore, researchers from Research Line 1 were members in several expert groups on early science education on behalf of the WIFF (Advancing Further Education of Early Childhood Professionals) and German Youth Institute (DJI) as well as the 'Little Scientists' House' Foundation. Recently, the IPN was also involved in the organization of the Forum on Educational Policy on "Opportunities of Early Education".

2 Ethnic disparities right from the start? Relevance of structural variables and process quality for early science learning of children with and without migration background (NEPS)

Introduction

NEPS
National Educational Panel Study

In modern societies an understanding of science and technology is vital to a young person's preparedness for life. Besides being able to read and write and to count and calculate, a person needs to be scientifically competent to be able to understand and participate fully in current and future developments of our society. This, of course, also holds true for the increasing number of people immigrating to Germany. One-third of the three- to six-year-old children in Germany have a migration background. Their successful participation in the German educational system and job market is of major social and economic importance.

Current statistics show that most of these migrant children attend kindergarten but only 27 % speak German at home. Currently, children with a migration background in Germany are less likely to successfully graduate from school or vocational training as children without a migration background. The Trends in International Mathematics and Science Study (TIMSS) recently provided further evidence that disparities in science competences are substantial at the end of Grade 4 (effect size of $d > 0.70$ in favor of students whose parents have no compared to students whose parents both have a migration background). In this vein, empirical studies underline the important role of quality of home learning or kindergarten environment for successful developmental trajectories of children. Quality of home learning environments can be differentiated into two components (see also above): First, structural characteristics such as the socio-economic background, the parents' level of education, the migration background and the number of siblings, and second, process quality which includes parent-child-interaction (e.g., providing learning opportunities) and the language at home. Research on kindergarten learning environment shows that process quality (e.g., interactions among children or between preschool teachers and children) has positive effects on the cognitive and social development of preschool children, whereas structural characteristics (e.g., group size, number of kindergarten teachers, number of rooms, learning materials) influence process quality.

Objectives

This study uses data from the starting cohort 2 (Wave 1) of the German National Educational Panel Study (NEPS) to identify structural variables and aspects of process quality and the extent to which they are associated with science skills of preschool children. Our predictions were as follows:

- Children with a migration background show lower science skills and less receptive German vocabulary than children without a migration background (P1).
- Structural variables and indicators of process quality significantly affect the science skills of preschool children (P2).
- Due to its significance for building conceptual knowledge the receptive German vocabulary is the strongest predictor for children's science skills (P3).
- Due to its assumed strong correlation with science skills on the one hand and with structural characteristics and process quality on the other hand the receptive German vocabulary functions as a mediator of the effect structural and process variables have on science skills (P4).

Method

The empirical basis consists of data from 2 947 children (50 % female, age: 4;3 to 6;1) from 269 kindergartens. We had data on the origin of 2 025 children which formed the subsample for our group comparisons. On the first day the children completed the thirty-minute NEPS science skills test containing 25 picture-based items and on the second day a receptive vocabulary test (based on the Peabody Picture Vocabulary Test – PPVT) containing 77 picture-based items was conducted to obtain information on their language proficiency. Concerning the structural variables and process quality, the main caregivers provided information on the number of books at home (1 = less than 10 books to 6 = more than 500 books), their highest educational level (International Standard Classification of Education – ISCED), the migration background (0 = no parent born abroad, 1 = one parent born abroad, 2 = both parents born abroad), the language at home (0 = another language, 1 = German) and the science-related activities at home (1 = never to 8 = multiple times a day). Furthermore, the number of siblings and the years attending kindergarten (< 1, 1, 2 or > 2 years) were included in the analyses. The children's age and gender were used as control variables.
To compare the groups of children with and without a migration background with regard to their science skills and receptive vocabulary we conducted *t*-tests (with Bonferroni correction) with SPSS 23. In our analy-

ses we used sum scores for the receptive vocabulary and weighted likelihood estimates (WLE) from IRT analyses (one-parameter model) for the science skills.
To estimate the effects of structural variables and process quality on the children's science skills we conducted regression analyses using Mplus7. The type = complex option in *Mplus* was used to account for the hierarchical structure of the data (children nested within kindergartens) and in order to get unbiased estimates of standard errors of all parameters.

Results

Comparison of the children with different migration backgrounds showed significant differences between all groups concerning their science skills (Figure 2) and their receptive vocabulary (P1, $p < .001$). As expected, the largest difference occured between children without any migration background and children whose parents were both born abroad, $t(480) = 16.31$, $p < .001$. The difference between children without migration background and children with one parent born abroad was also large and significant, $t(1732) = 4.41$, $p < .001$. Effect sizes (Cohen's d) are displayed in Figure 2.

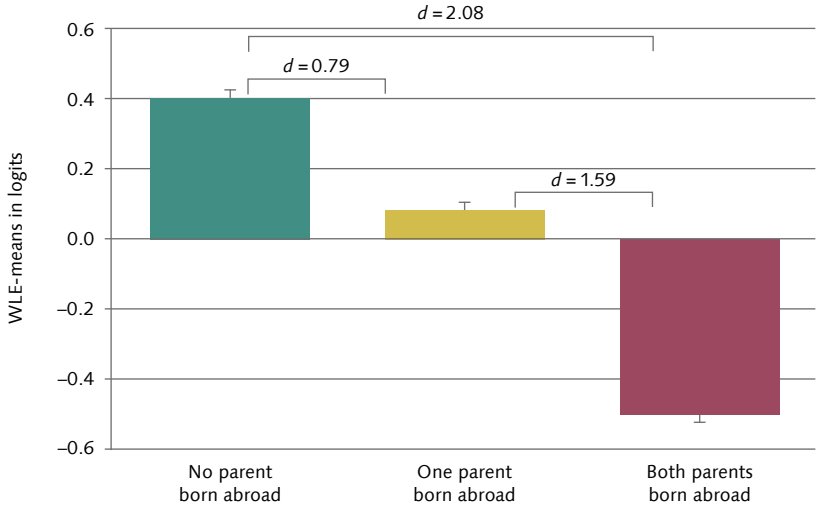


Figure 2. Comparison of the science skills of children with different migration backgrounds (means with standard errors); Cohen's *d:* effect size of mean differences.

The comparison of the children`s receptive German vocabulary conveyed a similar picture. However, the effect sizes of the respective differences were smaller: the difference between children without a migration background and children whose parents both had a migration background was d = 1.24 and the effect size of the difference between children with one compared to two parents born abroad was d = 0.59. Regression analyses (see Table 1) showed that all structural variables (years spent in kindergarten, migration background, number of books, ISCED and number of siblings) entered in Model 2 had significant effects (p < .001) on the children`s science skills (P2). The same applied to the language at home entered in Model 3 as a process variable (p < .001), while science-related activities had no effect on children's science skills (P2). As expected the receptive German vocabulary was the strongest predictor of children's science skills (β = .61, p < .001, incremental R^2 = .24; P3). When the receptive German vocabulary was included as a predictor in Model 4, the before mentioned effects of the structural and process variables on children's science skills were reduced or disappeared completely which can be indicative of a mediation effect (P4).

Table 1. Regression models (M1-M4): Standardized regression coefficients of the factors predicting science skills

Predictors	*M* 1	*M* 2	*M* 3	*M* 4
Gender	.03	.04*	.05*	.05*
Age	.25***	.22***	.22***	.15***
Structural variables				
Years spent in kindergarten		.11***	.11***	.06**
Migration background		-.18***	-.07*	.01
Number of books at home		.27***	.25***	.12***
ISCED (main caregiver)		.13***	.11***	.03
Number of siblings		-.11***	-.10***	-.05*
Process variables				
Language at home			.20***	.03
Science Activities			-.02	-.03
Receptive German vocabulary				.61***
R^2	.06	.30	.32	.56
ΔR^2		.24	.02	.24
N	**2 911**	**1 974**	**1 966**	**1 966**

Note.* p < .05, ** p < .01, *** p < .001; R^2 = explained variance in outcome variable, ΔR^2 = increase in explained variance, N = sample size.

Discussion

Our study showed that disparities in children's science skills already exist at the early age of four to six years. This result corresponds to research showing early disparities in verbal or mathematical competences. The differences in receptive German vocabulary were also highly significant although they were smaller than the differences in science skills. In combination with the regression analyses, this can be seen as evidence that the receptive German vocabulary is strongly connected with science learning in preschool. In this sense it forms a basis for the acquisition of science skills which, however, require more than just vocabulary. Our findings suggest that the receptive vocabulary mediates the effects of structural and process variables (namely the migration background, the socio-economic background, the number of siblings and the language at home) on science skills of the children. Keeping in mind that a lack of verbal competences in Germany often negatively influences the children's educational career, our results emphasize the importance of fostering verbal competences early and systematically. The earlier children learn the German language, the better the chances are of avoiding early disparities (in science and other domains). One way to implement this is early institutional learning in preschool with high structural and process quality.

IPN RESEARCH GROUP // Anna-Lena Gerken, Inga Hahn, Aiso Heinze, Jan-Marten Ihme, Jana Kähler, Olaf Köller, Lara Petersen, Dunja Rohenroth, Christian Schöber, Martin Senkbeil, Helene Wagner

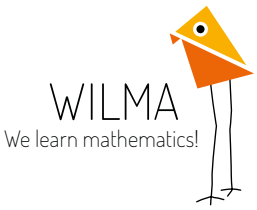
DURATION // 2017–2022

COOPERATION // Prof. Dr. Sabine Weinert (University of Bamberg; Leibniz Institute for Educational Trajectories, LIfBi) and the NEPS Network

HOMEPAGE // www.lifbi.de

3 Modeling and assessing kindergarten teachers' professional competence in mathematics (WILMA)

Introduction and objectives



Early domain-specific skills of preschool children have been identified as an important predictor for children's later school achievement. Since children's skill development depends, among other things, on the quality of opportunities to learn offered in kindergartens, kindergarten teachers' professional competence has become an important field of research over the last few years. In the project WILMA (**Wi**r **l**ernen **Ma**thematik, engl. We learn mathematics) we examined kindergarten teachers' professional competence in the domain of mathematics as well as its effects (1) on the quality of opportunities to learn mathematics offered in the kindergarten and (2) on the children's skill development in mathematics. The project focused on the mathematical subdomain of sets, numbers and operations for which a large body of empirical evidence about children's skill development is available. Based on this research evidence we identified indicators for instructional support of children's numerical development which were then used for the development of test instruments for kindergarten teachers' domain-specific professional competence.

For the investigation of teachers' professional competence we distinguished two competence dimensions which we adapted from research on primary and secondary teacher professional competence. We postulated that these dimensions on the one hand correspond with the two main types of kindergarten teachers' professional activities and on the other hand are linked to two different types of individual cognitive processes. The first dimension, *Reflective Competence* (RC), addresses kindergarten teachers' activities to prepare, analyze and reinforce opportunities to learn in the domain sets, numbers and operations. This includes for example the selection or adaption of learning materials for specific learning goals or the analysis of a child's learning processes as a basis for planning suitable new opportunities to learn. Kindergarten teachers must be able to adapt their mathematics-specific knowledge to prepare or to analyze a learning situation in which a child with specific learning prerequisites interacts with material. Inherent to the conceptualization of the RC dimension is that there is no time pressure for responding to these situations so that analytic decision making processes can take place to identify optimal solutions. In contrast, the second dimension called *Action-related Competence* (AC) corresponds to spontaneous activities during teaching situations needing immediate reaction. A typical example is an everyday kindergarten situation in which a specific child asks a mathematics-related question. An adequate immediate reaction of a kindergarten teacher might transform such a situation into a

fruitful opportunity to learn for the child. Such situations are characterized by time pressure so that due to a high cognitive load, analytic decision making processes cannot take place and intuitive or heuristic processes of knowledge usage are necessary to identify adequate solutions.
The project WILMA plans to examine effects of kindergarten teachers' domain-specific professional competence on the quality of opportunities to learn in kindergarten and on children's numerical skill development based on the previously described model. WILMA is an on-going project and in this report we focus on two research questions examining kindergarten teachers' professional competence:

(1) Is there empirical evidence for the postulated two dimensional model of professional competence with respect to the domain sets, numbers and operations?
(2) Can kindergarten teachers' reflective and action-related competence be fostered by specific professional development courses?

Method

The study followed a pre-post-intervention design. The sample comprised 161 kindergarten teachers from Germany (n = 80) and Switzerland (n = 81). RC and AC were measured twice within a computer-based test environment which allowed the implementation of the specific requirements for RC and AC. To measure AC the item stimuli consisted of short scripted video clips which could be watched only once. The video clips show typical situations of mathematical learning situations in kindergarten (e.g., playing board games) and ended requiring a teacher reaction. After watching the video, participants gave an immediate verbal answer into a headset microphone addressing the child in the video clip. The time to respond was limited, which mirrored the requirement of time-pressure.

Figure 3 illustrates an example for an AC item showing Florina and Linnea who discuss whether it is necessary to count when comparing two sets of four small circles and four large quadrangles. Florina looked into the camera and asked the kindergarten teacher to give an explanation to Linnea since she was not able to convince Linnea that counting is not necessary. Here, it was expected that the kindergarten teacher explains to Linnea that it is possible to establish a one-to-one correspondence between small circles and large quadrangles and that the size of the figures does not matter. There were 9 AC items which were scored with 0, 1 or 2 points (reliability of weighted likelihood estimates [WLE] from IRT analyses: t1: .70 / t2: .66).

The items to measure RC had fewer restrictions. The video-clips could be watched several times and there was no time limitation so that participants could work in their own speed. Again, the items showed kindergarten situations but they asked for a diagnosis of children's numerical skills or for planning an effective continuing opportunity to learn for the children in the video clip. There were 13 RC items which were scored with 0, 1 or 2 points (WLE reliability t1: .67 / t2: .66).

INTRO

Florina (right) and Linnea (left) playing with different shapes.

TASK

Please give Florinas friend an explanation, so that she can understand Florinas message! Please use Florinas laid-out shapes for your explanation!

VIDEO

Figure 3. Example of a video-based item to measure kindergarten teachers' AC.

Two specific interventions were conducted and compared with a control group to foster AC and RC. All kindergarten teachers were randomly assigned to three groups (group AC, group RC, control group). Each kindergarten teacher got a box with 10 dice- and card-games addressing children's numerical skills. In addition, the intervention groups for RC and AC were also provided with three training sessions within 4 months. The RC intervention addressed diagnosing children's level of mathematical skills, analyzing learning materials concerning their potential to foster mathematical development, and planning of learning opportunities for children. Within the AC intervention kindergarten teachers were trained in their spontaneous domain-specific interaction with children and to quickly recognize the mathematical potential of everyday learning situations. The control group did not get training between pre- and post-test but participated in a combined intervention after the post-test.

Results

A confirmatory factor analysis of data from the first measurement point indicated that a two-dimensional model separating RC and AC fits better than a unidimensional model (see Table 2). The latent correlation between RC and AC was moderate ($r = .50$, $p < .001$) which also supports the two-dimensional solution. Findings were replicated at time point 2.

The different character of RC and AC was supported by expected differences between the German and the Swiss kindergarten teachers in the sample. Due to the differences in kindergarten teacher education (mainly vocational in Germany, mainly academic in Switzerland), we expected the Swiss teachers to outperform the German teachers. As is indicated in Table 3 the differences between the two subsamples are larger for RC than for AC which plausibly reflects that a more comprehensive teacher education

Table 2. Model fit indices of the CFA with data from t1

Dimensions	CFI	TLI	RMSEA	$\chi^2/df/p$
1	0.79	0.65	0.16	44.015/9/< .001
2 (correlated factors AC and RC)	1.00	1.00	0.00	5.894/8/.66

Note. CFI: Comparative Fit Index; TLI: Tucker-Lewis-Index; RMSEA: Root-Mean-Square-Error of Approximation; *df:* Degrees of freedom; AC = action-related competence, RC = reflective competence.

Table 3. Differences between the German and the Swiss subsample at t1

	German teachers		Swiss teachers					
	M	*SD*	*M*	*SD*	*t*	*df*	*p*	Cohen's *d*
RC (max. 26 pts.)	8.50	3.44	11.78	3.44	-6.05	159	< .001	0.95
AC (max. 18 pts.)	7.22	3.00	9.41	3.33	-4.37	158	< .001	0.69

Note. AC = action-related competence, RC = reflective competence.

has a stronger impact on teachers' competence to plan and analyze situations (RC) than on competence for a direct interaction (AC) processes.

Concerning the second research question we conducted a repeated measurement ANOVA to analyze the effect of the teacher training on reflective and action-related competence (Figure 4).

The three groups differed in their change over time regarding the development of RC (significant interaction group x time: $F(2, 132) = 3.19$, $p < .05$, part. $\eta^2 = .05$).

Posthoc tests showed that this increase was larger for both the RC and AC training group compared to the control group. Differences in increase between the AC and RC group, however, were not significant. We found a similar tendency for the development of teachers' AC. The three groups differed in their increase in AC (interaction group x time: $F(2, 128) = 2.82$, $p = .06$, part. $\eta^2 = .04$) which again was due to the difference between control group and the two intervention groups.

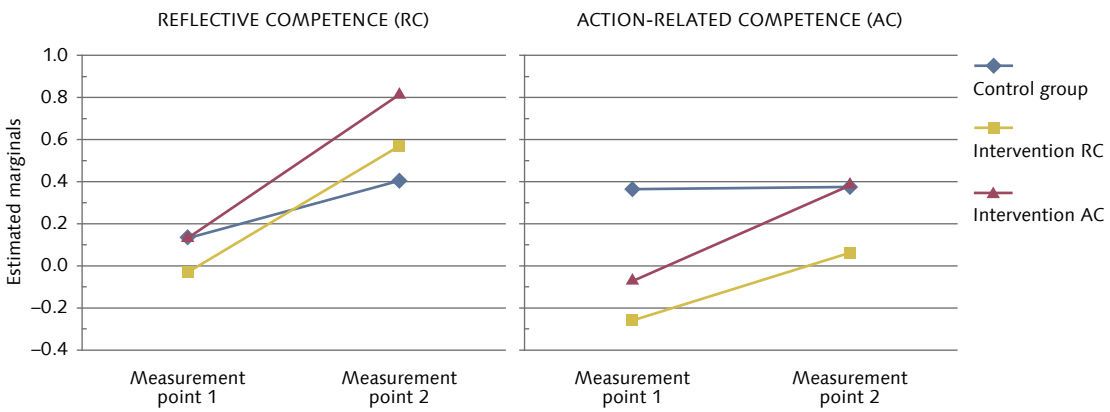


Figure 4. Effects of the intervention on RC and AC (means form repeated measurement ANOVAs based on WLE estimates).

Discussion

Our findings provide empirical evidence that a two-dimensional model of professional competence which distinguishes between AC and RC can be used in the context of kindergarten teachers. The expected differences between German and Swiss kindergarten teachers support the validity of the measurement. The results regarding the training of RC and AC indicate that it is generally possible to foster kindergarten teachers' professional mathematical competence in both dimensions. However, there are no hints that the RC intervention specifically fosters RC and the AC intervention only AC. A reason for this result might be that the intervention within the project was too short so that the effects on the correlated dimensions RC and AC could not be distinguished.
As outlined above, we also collected data on the quality of opportunities to learn mathematics in kindergarten and on children's numerical skills. This allows investigating the influence of teachers' RC and AC on teaching quality and on children's numerical skill development in future analyses.

IPN RESEARCH GROUP // Simone Dunekacke, Aiso Heinze, Anke Lindmeier & Selma Seemann

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COOPERATION // University of Koblenz-Landau, University of Teacher Education St. Gallen, University of Zurich

HOMEPAGE // www.ipn.uni-kiel.de/en/the-ipn/departments/mathematics-education/forschung-und-projekte/WILMA?set_language=en

Perspectives for Research Line 1

In the near future Research Line 1 will continue its work in the ongoing projects NEPS and BRISE, data from completed projects will also be used for further analysis. Moreover, we will continue the recently started projects Effective learning environments in children's understanding of the scientific inquiry cycle (LESIC) and Formative assessment in inclusive science education in Kindergarten (FinK).

In the LESIC project we aim to compare the effectiveness of different learning environments for supporting preschool children's first understanding of the scientific inquiry cycle (SIC), one central aspect in the broad field of procedural knowledge (cf. Scientific Literacy) that emphasizes the idea of inquiry as intentional knowledge seeking comprising different steps which are cyclical and cumulative. There is some evidence suggesting that procedural knowledge plays a crucial role in the acquisition of new knowledge and children's preparation for future science learning. Therefore, findings about effective learning environments for the acquisition of procedural knowledge in ECEC are important in view of future research in Research Line 1 on learning from ECEC to primary school. In this project we employ a quasi-experimental intervention study with children between the age of 5 and 6 years which differ in regard to the instructional support and the (dis)similarity of examined phenomena. The main study will be conducted in 2019.

In the recently started project FinK we focus on pedagogical interactions of ECEC teachers in inclusive science learning environments. Inclusion is one great task of our education system. However, there is a substantial lack of knowledge in the field on science-specific inclusive learning settings. FinK investigates the effects of different professional development workshops on the quality of inclusive science learning environments in kindergarten and the development of science competences of 4–6 year old children. The main focus of the professional development is formative assessment and adaptive instruction. The main study will be implemented at the end of 2019.

Furthermore we will continue and enhance the research cooperation EARLYEd. Appropriate steps have already been taken by launching the mentioned grant proposal which was submitted to the German Research Foundation (DFG). Research Line 1 is engaged in research on the interface of research and politics such as in BRISE, but also in more fundamental projects such as the LESIC project. This broad range shall be continued and further develop in order to build up the still relativly new Research Line 1.

Projects in Research Line 1:

Project // Homepage	**Structure of early childhood educators' domain-specific professional competences and their effects on the quality of mathematical instructional situations in kindergarten and on children's increase in mathematical competences (WILMA – We learn mathematics!) //** www.ipn.uni-kiel.de/en/the-ipn/departments/mathematics-education/forschung-und-projekte/WILMA?set_language=en
Funded by	German Research Foundation (DFG) / Swiss National Science Foundation (SNF)
Term	2015–2018
Departments involved	Mathematics Education
Staff (IPN)	Simone Dunekacke (– 9/2018), Aiso Heinze, Anke Lindmeier, Selma Seemann
Cooperation partners	University of Koblenz-Landau // University of Teacher Education St. Gallen // University of Zurich
Project // Homepage	**Bremen initiative to foster early childhood development (BRISE) //** https://www.brise-bremen.de
Funded by	Federal Ministry of Education and Research (BMBF), Free Hanseatic City of Bremen, Jacobs Foundation
Term	2016–2020
Departments involved	Educational Research and Educational Psychology, Mathematics Education, Chemistry Education
Staff (IPN)	Aiso Heinze, Olaf Köller, Kerstin Schütte, Mirjam Steffensky
Cooperation partners	Freie Universität Berlin // German Institute for Economic Research, DIW Berlin // German Institute for International Educational Research, DIPF // Heidelberg University // Leibniz Institute for Educational Trajectories, LIfBi, University of Bamberg // Max Planck Institute for Human Development // University of Bamberg // University of Bremen
Project // Homepage	**Early steps into science (EASI science) //** www.ipn.uni-kiel.de/de/forschung/projekte/easi-science
Funded by	Federal Ministry of Education and Research (BMBF), Foundation „Haus der kleinen Forscher"
Term	2013–2017
Departments involved	Chemistry Education
Staff (IPN)	Julia Barenthien, Mirjam Steffensky
Cooperation partners	Freie Universität Berlin // Goethe University Frankfurt / Main // University of Koblenz-Landau
Project	**Formative assessment in inclusive science education in Kindergarten (FinK)**
Funded by	Federal Ministry of Education and Research (BMBF)
Term	2018–2021
Departments involved	Chemistry Education
Staff (IPN)	Katharina Junge, Mirjam Steffensky
Cooperation partners	Goethe University Frankfurt / Main // Leipzig University // University Landau
Project // Homepage	**Science-specific spiral curricula from preschool to secondary level (MINTeinander) //** www.telekom-stiftung.de/projekte/minteinander
Funded by	Deutsche Telekom Stiftung
Term	2009–2018
Departments involved	Chemistry Education
Staff (IPN)	Mirjam Steffensky
Cooperation partners	Goethe University Frankfurt / Main // Leipzig University // Münster University // School of Education north-western Switzerland // University of Landau
Project // Homepage	**National educational panel study (NEPS) //** www.lifbi.de
Funded by	Leibniz Institute for Educational Trajectories
Term	2017–2022
Departments involved	Educational Research and Educational Psychology, Mathematics Education
Staff (IPN)	Anna-Lena Gerken, Inga Hahn, Aiso Heinze, Jan-Marten Ihme, Jana Kähler, Olaf Köller, Lara Petersen, Dunja Rohenroth, Christian Schöber, Martin Senkbeil, Helene Wagner
Cooperation partners	Leibniz Institute for Educational Trajectories, LIfBi, University of Bamberg and the NEPS Network
Project	**Effective learning environments in children's understanding of the scientific inquiry cycle (LESIC)**
Funded by	
Term	2017–2020
Departments involved	Chemistry Education
Staff (IPN)	Jana Mohr, Daniel Schmerse, Mirjam Steffensky
Cooperation partners	