

BELIEFS OF KINDERGARTEN AND PRIMARY SCHOOL TEACHERS TOWARDS MATHEMATICS TEACHING AND LEARNING

Rebecca Kröger, Stephanie Schuler, Nadine Kramer, Gerald Wittmann

University of Education Freiburg, Germany

Kindergarten and primary school teachers' professional actions and beliefs are assumed as crucial factors for successful transition. Individual interviews with kindergarten and primary school teachers, video observations in both institutions and focus groups were analysed to describe these beliefs. A spectrum of different beliefs was outlined. Kindergarten and primary school teachers have different views on mathematics due to different curricula and different trainings. The Research results are used to support the process of professionalization.

Keywords: Kindergarten, primary school, teacher beliefs

INTRODUCTION

In Germany, there exist differences between kindergarten and primary school concerning curricula (1), teachers' qualification (2) and the organisation of (mathematical) learning (3).

(1) In the *Orientierungsplan* for kindergarten (Ministerium für Kultus, Jugend und Sport Baden-Württemberg, 2011) no standards but goals are outlined. Everyday situations and their learning potential are described. In the *Bildungsplan* – the curriculum for primary school (Ministerium für Kultus, Jugend und Sport Baden-Württemberg, 2004) – specific content and process ideas are formulated; standards and competencies children should gain in different subjects.

(2) Kindergarten teachers are mainly trained in vocational schools. Since eight years students have the possibility to gain a bachelor degree in early childhood education. Primary school teachers study at university and have an academic degree.

(3) In Germany, children attend kindergarten from the age of 3 to the age of 6 in heterogeneous age groups. Daily routine in kindergarten are for example free play or open assignments. Primary school usually starts at the age of 6, depending on the federal state of Germany. Classes are mostly organised in homogenous groups. The morning is structured around lessons in different subjects.

In this study, the alignment of kindergarten and elementary school teachers' beliefs of mathematics instruction and teaching practices is seen as a basic condition for the interconnection between early childhood and primary school education. However, it is assumed that due to the different conditions differences and inconsistencies exist. Predominant beliefs in both institutions will be described.

THEORETICAL FRAMEWORK

Two aspects are important for the theoretical framework: Beliefs and aspects concerning transition from kindergarten to primary school.

There is no universal definition of “beliefs” (Pajares, 1992). Furthermore, there are different almost synonymous terms like ‘concepts’, ‘subjective/implicit theories’, ‘attitudes’ or ‘values’. The following findings on beliefs shall give an overview on what beliefs are (Pajares, 1992, p. 325-326):

- “The belief system has an adaptive function in helping individuals define and understand the world and themselves.
- By their very nature and origin, some belief structure, the more incontrovertible than others.
- The earlier a belief is incorporated into the belief structure, the more difficult it is to alter. Newly acquired beliefs are more vulnerable to change.
- Individuals’ beliefs strongly affect their behaviour.”

Green (1971) characterised beliefs as followed: Beliefs are quasi-logical, they have a psychological centrality and are organised in clusters.

In spite of the various meanings of beliefs, there is a broad acceptance that teachers’ instructional practices are influenced by their belief systems (Calderhead, 1996). These practices impact on students’ learning and beliefs concerning mathematics (Hiebert & Grouws, 2007). Therefore, much effort was made to investigate mathematical beliefs of teachers in the recent two decades all over the world (Philipp, 2007).

In Germany, there are several studies concerning the mathematical beliefs of high school teachers (COACTIV, Kunter et al., 2011), a few concerning the beliefs of kindergarten teachers (Thiel, 2010 or Benz, 2012) as well as primary school teachers (Bräunling et al., 2011).

Transition from kindergarten to primary school is marked by continuity and discontinuity. Therefore, two different positions exist: (1) Differences should be reduced to increase continuity and to allow a gradual and smooth transition. (2) On the other hand, discontinuities can be seen as challenges beneficial to (personal) development.

According to Hacker (2004), there are several reasons for a gap in transition from kindergarten to primary school:

- Different understanding of education of kindergarten and primary school teachers
- Different training of the two professions

- Different establishments who are responsible for the institutions (State, private establishments etc.)

To allow every individual a continuous educational biography (Heinze & Grüßing, 2009), cooperation between both institutions – kindergarten and primary school – is indispensable (Hacker, 2004). Goals and contents of both institutions should be made transparent (Griebel & Niesel, 2003).

RESEARCH OBJECTIVES

The goal of this interdisciplinary project is to design a well-grounded structural model of epistemological beliefs on teaching mathematics.

The data will be gathered with a questionnaire survey in two federal states of Germany – Bremen and Baden-Württemberg.

In a qualitative study data was collected for designing the questionnaire in a bottom-up process. The data was also preliminary used for analysing and interpreting the beliefs. In this paper, we will present only the qualitative study of Baden-Württemberg.

Various research questions, outlined below, guided the data collection and the data analysis. The following ones are important for the qualitative study.

1. What kind of hands-on materials are used in kindergarten and primary school?
2. How do kindergarten and primary school teachers support the transition from kindergarten to primary school in regard to mathematics?
3. What do kindergarten and primary school teachers consider relevant for the mathematical development of children?
4. What kind of transition practices can be found?

METHODOLOGY

The data was collected by using guided interviews subsequent to video-observations (Dinkelaker & Herrle, 2009) and with focus groups (Morgan, 1997).

The guided interviews were conducted with six kindergarten and six primary school teachers. All interviewees were female. They differed from age and teaching experience.

The interview manual contained the following topics: Planning and arrangements for teaching, interaction between teacher and child, materials used for learning mathematics, goals of teaching mathematics, cooperation between kindergarten and primary school. After each interview notes were taken in a postscript (Witzel, 1982): Comments on situational and non-verbal aspects, conversational contents and the explanation of priorities of the interviewees.

The professionals were asked to show a typical mathematical kindergarten situation or a typical mathematics lesson for first-graders. All situations and lessons were videotaped.

In two focus groups (Morgan, 1997), 35 kindergarten and primary school teachers exchanged their views on early mathematics education, the transition from kindergarten to primary school and the cooperation between both institutions. We invited highly experienced experts of whom some work in teacher training. We asked them to bring along typical hands-on materials, textbooks, etc.

Focus groups were conducted because they are an economic alternative to conventional interviews. More individual opinions can be gathered in one run. In addition, the atmosphere in focus groups is more relaxed than in interviews. Not everyone is needed all the time thus there are possibilities to withdraw. As well, thoughts and utterances can be stimulated by listening to other participants. Therefore, there are often more ideas than in a guided interview with only one person (Bortz & Döring, 2006).

The interviews and the audio data from the focus groups were transcribed verbatim. The data was analysed by coding according to the qualitative content analysis (Mayring, 2010). One part of this analysis, the paraphrase, was used to create items for the questionnaire.

ANALYSIS AND PRELIMINARY INTERPRETATION

The following analysis refers to the outlined research questions (1–4); ordered chronologically.

(1) In kindergarten, two different types of materials can be found: everyday objects (cf. figure 2-3) and special mathematical programmes and trainings (cf. figure 1). According to kindergarten teachers everyday objects comprise objects from nature, e.g. nutshells, stones or chestnuts, as well as objects that surround children in their everyday life, e.g. Schleich figurines (authentic figures made from rubber), games, dice, etc. Kindergarten teachers use these materials because mathematics can be found everywhere, therefore – according to their point of view – no specific material is needed. This way, children can understand the omnipresence of mathematics. The materials showed and used in group discussions and in the interviews can nearly all be classified as materials for ‘number and operations’. Special mathematical programmes and trainings are inserted to prepare the children specifically for school (*Zahlenland* Preiß, 2007, Friedrich & de Galgóczy, 2008 and *Mengen, zählen, Zahlen* Krajewski et al., 2007). Programmes and trainings also refer mostly to the content area ‘number and operations’ (NCTM, 2000). The key contents in the programme ‘Zahlenland’ (English equivalent: land of numbers) (Preiß, 2007 or Friedrich & Galgóczy, 2008; cf. Figure 1) are knowledge of numerals and counting abilities. Each numeral is presented in a separate story using special characters. Matching songs and various activities complete the examination of one numeral. Some kindergarten

teachers mentioned that they work with such programmes to prepare children ideally for school and to make the transition in mathematics easier. Kindergarten teachers who do not work with special programmes do so for various reasons. Either, they did not attend further education programmes for mathematical training or they do not see an importance in teaching some mathematical aspects before school as transition was no problem until now. Furthermore, some kindergarten teachers consider teaching and learning mathematics explicitly as inappropriate for this age group.

On the other hand, primary school teachers prefer didactical hands-on materials for the arithmetic instruction (cf. figure 4-6). Some hands-on materials (cf. figure 3) shall help children to learn the recording of numbers simultaneously well.



Figure 1-3: Hands-on materials used in kindergarten



Figure 4-6: Hands-on materials for arithmetic instruction in primary school

(2) In the interviews and in the group discussions the primary school teachers stress the heterogeneity of children at the beginning of their school career which influences and sometimes hinders their work. In the teachers' view the reason for the children's heterogeneity is based on the fact that the children attend different kindergartens. Because of this, they have different mathematical experiences. Teachers try to meet the heterogeneity with group and individual work as well as action-oriented teaching. The goal is to facilitate the beginning of school for all children. Also, during the visits of the cooperation teachers in the last year of kindergarten, mutual areas and actions

for a successful transition in mathematics are named in cooperation with the kindergarten teachers. The children should complete these areas and activities in kindergarten in order to obtain optimum conditions to start school.

(3) In connection with the question which relevant skills children should acquire before entering school, implicit demands are made towards the other institution. This is especially true for primary school teachers. In some cases the interviewed primary school teachers expressed different abilities and skills the children should master: On the one hand, these are domain specific skills like counting, record numbers up to five simultaneously and on the other hand daily living skills such as to tie shoes, to hold a pencil correctly, etc. Other interviewees wished that kindergartens should operate in a way that allows the children to gain first mathematical experiences.

Some kindergarten teachers expressed several times that they consider counting as very relevant and important for the development of the children and for a successful start of their school career. Other kindergarten teachers, however, see their role in mediating and arising joy and curiosity for mathematics. The primary school teachers interviewed think primarily of special skills that are important for a successful start in school. The kindergarten teachers, however, do consider some skills as relevant too but put their main emphasis on the teaching of certain attitudes. These differences are probably related to the aims of the institution. Schools have clearly defined standards to achieve but kindergartens do not. This can already be found in the underlying curricula.

(4) In Baden-Württemberg, the cooperation between kindergarten and primary school is recorded in the curricula. The way and extend of the cooperation is not described. Nevertheless, different forms of cooperation were established and used in the last few years. Often, one teacher per school is responsible for the cooperation between kindergarten and school. This teacher is called *cooperation-teacher*. The cooperation-teacher is not always the teacher of the first-graders. He/She cooperates with those kindergartens from which children will enter their school. The cooperation-teachers visit the children in their last year of kindergarten on a regular basis, normally every second month. In this time they play with them, look for things kindergarten teachers could do with the children till entering school so that they are well prepared, etc. Part of the cooperation often is that the kindergarten children take part in a lesson in school once.

Both kindergarten and primary school teachers mentioned that there is not enough time to have an intensive cooperation. They agree that there should be much more capacities for having an in- and extensive cooperation. Nevertheless, both think that cooperation between the institutions is a key component of the transition process. The

children should already get to know their future teacher and future classmates before their first day of school. They criticised the fact, that the cooperation-teacher and not the teacher of the new first grade is responsible for the cooperation. 'Round tables', at which kindergarten teachers and primary school teachers meet on a regular basis, reciprocal visits, the broadening of cooperation over a longer period of kindergarten time and the integration of the entire team into the alliance in order to abolish the restriction of responsibility to only one cooperative force, were wishes expressed by the respondents.

SUMMARY AND DISCUSSION

The transcripts of individual interviews and focus groups with kindergarten and primary school teachers were preliminary analysed to describe the beliefs of those professionals.

In kindergarten, everyday objects are used primarily and in primary school didactical hands-on materials are used. The use of everyday objects focuses on a broad view of mathematics – mathematics is not only reduced to numbers, counting and calculations – which is at the same time non-specific. Some interviewees described how they work with these materials. Those reports suspect a limited view on mathematics as the materials are primarily used for counting. To what extent the views of the teachers are related to their choice of material needs to be proven.

The interviewed primary school teachers name different mathematical skills as helpful to be taught in kindergarten. These are mainly counting, knowledge of numbers, recording numbers simultaneously and the assignment of number images and numerals. The interviewed kindergarten teachers name domain-specific skills less often. They strongly emphasize that they see their task in imparting fun with numbers and to arouse curiosity about mathematics, which should be continued by the teachers in school. Here, the influences of the tradition of the institutions are visible. In primary schools standards have to be achieved. In kindergarten, a socio-pedagogical view is dominant which influences the educators' work as well as their point of view (OECD, 2006).

Between the previously surveyed teachers a consensus on the relevance of cooperation exists. Often, the children get to know the school in their last year of kindergarten. The cooperation-teacher visits the children in kindergarten and they are allowed to attend a lesson in school. Two views on the cooperation can be distinguished: (1) A child-centered/pedagogical view: Kindergarten and primary school cooperate to allow the children to get to know their possible future teacher, the new environment at school, etc. and to facilitate their first day at school. Primary school teachers and kindergarten teachers with this point of view maintain a strong cooperation. Projects are initiated together, they are organised over a longer period of time and do not only focus on future 1st-graders. (2) Cooperation and kindergarten is only seen as a preparation for school. The aim of kindergarten is to prepare the

children appropriately for school to allow primary school teachers a direct start with 'proper lessons'. In this case, cooperation is limited. The cooperation-teacher visits the children in their last year of kindergarten approximately three times to diagnose the children and to give hints on individual training programmes.

The curricula of both institutions have an influence on the perspectives of the professionals as well as on their practices. Also, it can be interpreted that the different traditions of kindergarten and primary school are reflected in their beliefs. One example for the inconsistencies of beliefs is that some interviewees work with programmes in kindergarten and emphasize the omnipresence of mathematics at the same time.

The influences of beliefs as well as the quantitative distribution are still not clear. The questionnaire based study in Bremen and Baden-Württemberg will provide information about this issue.

Findings from the project will serve the process of professionalization of both professions in training as well as in in-service trainings.

REFERENCES

- Benz, C. (2012). Attitudes of Kindergarten Educators about Math. *Journal für Mathematik-Didaktik*, 33 (2), pp. 203–232.
- Bortz, J. & Döring, N. (2006). *Forschungsmethoden und Evaluation für Human- und sozialwissenschaftler*. Berlin: Springer.
- Bräunling, K., Eichler, A. & Mischo, C. (2011). Subjektive Theorien von Lehrerinnen und Lehrern zum Lehren und Lernen von Arithmetik (STELLA I). *Beiträge zum Mathematikunterricht* (pp. 927–928). Münster: WTM-Verlag.
- Calderhead, J. (1996). Teachers: beliefs and knowledge. In D.C. Berliner (Ed.), *Handbook of education* (pp. 709–725). New York: MacMillan.
- Dinkelaker, J. & Herrle, M. (2009). *Erziehungswissenschaftliche Videographie – Eine Einführung*. Wiesbaden: VS Verlag für Sozialwissenschaften.
- Friedrich, G. & de Galgóczy, V. (2008). *Komm mit ins Zahlenland*. 4. Aufl. Stuttgart.
- Green, Th.F. (1971). *The activities of teaching*. McGraw-Hill, New York.
- Griebel, W. & Niesel, R. (2003). Die Bewältigung des Übergangs vom Kindergarten in die Grundschule. In Wassilios E. Fthenakis (Ed.), *Elementarpädagogik nach PISA. Wie aus Kindertagesstätten Bildungseinrichtungen werden können* (pp. 136–151). Freiburg: Herder.
- Hacker, H. (2004). Die Anschlussfähigkeit von vorschulischer und schulischer Bildung. In Faust, G. et al. (Ed.), *Anschlussfähige Bildungsprozesse im Elementar- und Primarbereich* (pp. 273–284). Bad Heilbrunn: Klinkhardt.

- Heinze, A. & Grüßing, M. (Ed.) (2009). *Mathematiklernen vom Kindergarten bis zum Studium: Kontinuität und Kohärenz als Herausforderung für den Mathematikunterricht*. Münster: Waxmann.
- Hiebert, G.D. & Grouws, J. (2007). The effect of classroom mathematics teaching on students' learning. In F. Lester (Ed.), *Second handbook of research on mathematics teaching and learning* (pp. 371–404). Charlotte: Information Age Publishing.
- Krajewski, K.; Nieding, G. & Schneider, W. (2007). *Förderboxen für KiTa und Anfangsunterricht: KiTa-Förderboxen: Mengen, zählen, Zahlen (MZZ): Die Welt der Mathematik verstehen. Koffer mit Fördermaterialien und Handreichungen*. Berlin: Cornelsen.
- Kunter, M., Baumert, J., Blum, W., Klusmann, U., Krauss, S., & Neubrand, M. (Ed.) (2011). *Professionelle Kompetenz von Lehrkräften - Ergebnisse des Forschungsprogramms COACTIV*. Münster: Waxmann.
- Mayring, P. (2010). *Qualitative Inhaltsanalyse. Grundlagen und Techniken*. Weinheim und Basel: Beltz.
- Ministerium für Kultus, Jugend und Sport Baden-Württemberg (Ed.) (2011). *Orientierungsplan für Bildung und Erziehung in baden-württembergischen Kindergärten und weiteren Kindertageseinrichtungen*. Retrieved from: http://www.kultusportal-bw.de/servlet/PB/show/1285728/KM_KIGA_Orientierungsplan_2011.pdf [09.02.2012]
- Ministerium für Kultus, Jugend und Sport Baden-Württemberg in Zusammenarbeit mit dem Landesinstitut für Erziehung und Unterricht Stuttgart (Ed.) (2004). *Bildungsplan Grundschule 2004*. Retrieved from: http://www.bildung-staerkt-menschen.de/service/downloads/Bildungsplaene/Grundschule/Grundschule_Bildungsplan_Gesamt.pdf [20.01.2012]
- Morgan, D.L. (1997). *Focus Groups as Qualitative Research. Second Edition*. California: Sage Publications.
- [NCTM] – National Council of Teachers of Mathematics (2000). *Principles and Standards for School Mathematics*. Reston, VA. Retrieved from: <http://www.nctm.org> [18.03.2011]
- OECD (2006). *Starting strong II. Early Childhood Education and Care*. Paris: Organization for Economic Cooperation and Development. Retrieved from: <http://www.oecd.org/dataoecd/14/32/37425999.pdf> [07.03.2011]
- Pajares, M.F. (1992). Teachers' Beliefs and Educational Research: Cleaning Up a Messy Construct. *Review of Educational Research*, 62(3), pp. 307–332.

- Philipp, R. (2007). Mathematics teachers' beliefs and affect. In F. Lester (Ed.), *Second handbook of research on mathematics teaching and learning* (pp. 257–315). Charlotte: Information Age Publishing.
- Preiß, G. (2007). *Leitfaden Zahlenland 1*. 2. Aufl., Bad Camberg.
- Thiel, O. (2010). Teachers' attitudes towards mathematics in early childhood education. *European Early Childhood Education Research Journal*, 18(1), pp. 105–115.
- Witzel (1982). *Verfahren der qualitativen Sozialforschung. Überblick und Alternativen*. Frankfurt a. M.: Campus.

The project this report is based on is supported by the *Bundesministerium für Bildung und Forschung* and by the *Europäischen Sozialfonds* of the European Union under the promotion code 01NV1025/1026 and 01NV1027/1028. The authors take the responsibilities for the content of this publication.