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From Preschool to Vocational Training and Tertiary Education—Study Design of the BiKS-3-18 Study

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Abstract

The educational development and achievements of children depend on individual prerequisites as well as on familial and institutional learning contexts. Data from the study BiKS-3-18 (Educational Processes, Competence Development, and Formation of Educational Decisions in Preschool and School Age) enables educational research on mechanisms and long-term effects of early child development and different learning environments in Germany. This contribution provides an overview of the study design, sampling procedures

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and sizes, contents, and research potential of the BiKS-3-18 study. Starting in 2005, the study followed preschool children from Bavaria and Hesse from the age of three over fifteen years, from preschool through primary and secondary school, including their educational and vocational career paths beyond compulsory schooling into the labor market or tertiary education. The study comprehensively assessed children's competencies and their familial and institutional learning environments particularly across preschool and primary school (ten assessment waves). Additionally, children's parents and teachers were interviewed. The initial sample consisted of 547 preschool children and added 528 of their classmates in primary school after enrollment. Furthermore, both after the transition from primary to secondary education and after the transition from secondary education to vocational or tertiary education, children and their parents were again tested and interviewed until the children were 18 years old (three additional assessment waves).

Keywords

Preschool · Primary school · Secondary school · Educational trajectories · Longitudinal data

1 Introduction

The BiKS-3-18 study was launched in 2005 to address public and scientific expectations and concerns about the impact of the early years, including home and institutional learning experiences as well as early developmental trajectories for later developmental and educational pathways and outcomes. Its conception was affected by three main research strands: First, the striking findings from randomized control trials in the U.S. showed that high-quality preschool programs such as the Perry Preschool Project (Belfield et al. 2006), the Abecedarian Project (Campbell and Ramey 1994), and the Head Start Program (U.S. Department of Health and Human Services, Administration for Children and Families 2010) were associated with enhanced academic and social development of children into early adolescence and beyond (Barnett 2011; Campbell et al. 2001; for an overview, see Blau and Currie 2006; Burger 2010; Duncan and Magnuson 2013). However, the transferability of the results to public child care arrangements and to other cultural contexts was limited due to small and specifically disadvantaged samples. Second, the results from large scale longitudinal studies investigating the combined effects of different child care and family contexts on children's

development within more diverse samples in the U.S. (e.g., the National Institute of Child Health and Human Development [NICHD] Study of Early Child Care and Youth Development; Belsky et al. 2007) and Great Britain (the Effective Provision of Pre-school Education [EPPE]/the Effective Pre-school, Primary and Secondary Education Project [EPPSE]; Sylva et al. 2004) also showed positive effects, but again with the limitation of the cultural transferability to the German context. And third, there was a large research gap in developmental psychology regarding early roots and significant pathways toward later school-relevant competencies. Thus, the idea of a longitudinal study tracking children from preschool entry to school enrollment with a socially and culturally diverse sample was born. By launching the longitudinal BiKS study in 2005, the attempt was made to close the main existing theoretical and empirical research gaps concerning how families, preschools, and primary schools affect developmental and educational processes in their interplay with children's developing individual characteristics (see also von Maurice et al. this volume).

Although its initial focus lied on children's development from the age of three years to the end of primary school, the study accompanied these children further through adolescence and has incorporated an extensive range of measures over the course of children's educational careers. As a consequence, it enables researchers to explore a wide variety of topics ranging from early child care, early educational decisions, and individual child trajectories, including origins of school readiness, to insights into the developmental dynamics, influencing factors, and interrelations between different domains of development such as language, (meta-)cognition, mathematics, and facets of social-emotional development including predictors of early and later social cognition; the interplay between various learning environments synchronous as well as over time, and the specificity of environmental impacts; predictors of children's later social-emotional competencies, aspects of life satisfaction, coping with life, integration into society, and further important issues.

The BiKS-3-18 study focuses on cumulative educational experiences, developmental processes, decision-making processes, and their interrelations that take place over the whole time that children in Germany usually spend in institutional, formal learning environments, i.e., from preschool at age three to the end of upper secondary schooling and the beginning of tertiary education or in vocational education and training (VET) at age 18. Together with BiKS-8-18 (see Homuth et al. this volume), these two studies provided the rich data basis of the two-cohort-study BiKS (see von Maurice et al. this volume).

While other chapters of this volume provide insights into findings of the BiKS study concerning the main research questions as well as more differentiated

overviews on the assessments, the present chapter provides a comprehensive overview of the design, the sampling procedure, the sample development, general study contents, and the research potential of the data.

2 Study Design

The unique features of the BiKS-3-18 study include (a) participants growing up in different regions (including urban, suburban, and rural areas) of two federal states within Germany, representing different sociodemographic contexts and varying preschool and school regulations; (b) inclusion of different cultural backgrounds, family forms, and levels of education within families; (c) a sample large enough to permit complex statistical modeling; (d) children followed from age three onwards at the beginning of their institutional educational career; (e) extensive direct observations of home, child care, and school experiences; (f) multiple measures of cognitive, social-cognitive, and language development, of mathematical and literacy skills, educational achievements, and social-emotional development; (g) longitudinal use of multiple quality indicators for the learning environments with differences in scope, method, and depth.

2.1 Multi-informant Panel Design

BiKS-3-18 is a panel study in which children were tested annually, sometimes even semi-annually, in several developmental domains (see Weinert and Ebert this volume). In addition, extensive information about the family and institutional contexts (preschool, primary school, secondary school) was collected through a variety of interviews of parents, teachers, and later the students themselves, as well as direct observations in the family or the classroom (see Fig. 1).

In September 2005, a sample of $n = 547$ preschool children was drawn who would regularly enroll into school in September 2008. This sample was followed through the end of upper secondary schooling and VET. In Wave 1 in 2005, children were on average three and a half years old ($M = 42.2$ months; $SD = 4.1$) and on average 18 years in Wave 13 in 2020 ($M = 218.3$ months; $SD = 4.5$).

In total, individual data on the children and their families were collected at 13 panel waves with six biannual waves during the preschool, four annual waves in the primary school phase, two additional waves in the lower secondary schooling, and one wave in the educational stage of upper secondary education or VET (see Fig. 1). During the preschool period, children's competencies in various domains

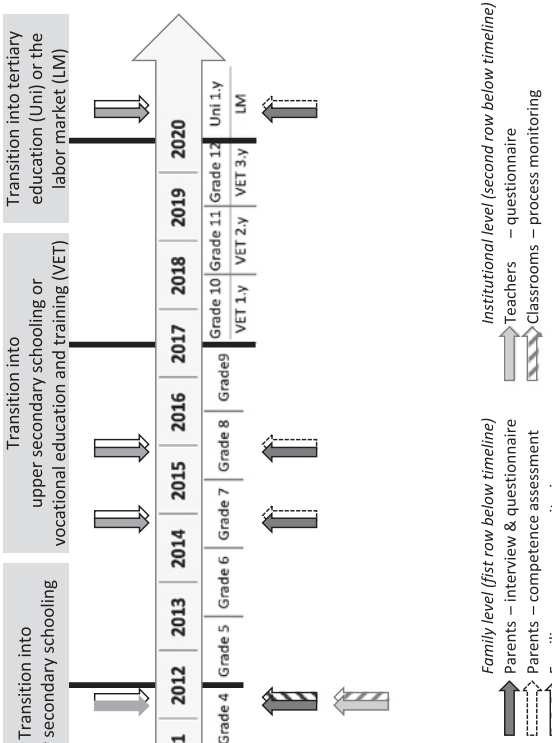

Fig. 1 Study design of BiKS-3-18

were assessed at least yearly for the full sample, while their parents were interviewed and filled out questionnaires to assess, amongst other topics, the familial learning environments which were also directly observed (see Rossbach et al. this volume). A sub-sample of participating children was tested every six months to map their development in this age range in even greater detail (see Weinert and Ebert this volume).

Most waves during the preschool and school period also included observations and questionnaires within the institutional settings. The school or classroom learning environments were assessed partly on a six-month basis, and (pre)school teachers and (pre)school heads were regularly interviewed to be able to analyze classroom and school effects on students' educational developments.

A sub-sample of parents ($n = 68$), preschool teachers ($n = 29$), and primary school heads ($n = 16$) was examined with qualitative interviews during, before, and after the transition from preschool to primary school with a focus on school entry decisions and school readiness (Faust et al. 2013; Pohlmann-Rother et al. this volume). Another sub-sample of systematically selected children ($n = 68$) was tested in depth in preschool age with a focus on metacognition, theory of mind, and specific aspects of the home learning environment (see Weinert and Ebert this volume, for details).

Two additional waves were completed after the transition into secondary schooling when children were about 12 and 13 years old. The last wave took place when children were about 18 years old. These final three waves focused only on students, their individual educational status, and their parents. They included competence assessments, interviews, and questionnaires for both students and parents on different aspects of students' educational developments (see Weinert and Ebert this volume, for details).

2.2 Sampling Process

In addition to criteria such as the generalizability and reliability of the data as well as the possibilities for analysis, practical considerations played a role in drawing the initial sample. On the one hand, the sample had to allow statistically reliable statements about the developmental processes and their influencing factors in the target population while considering the greatest possible diversity of family and institutional contextual conditions. On the other hand, this should be feasible with the given time and financial as well as personnel resources, since the design of the BiKS studies with its repeated and extensive data collection represented a major organizational challenge.

Therefore, a multiple stratified random sample was drawn (see Sect. 2.2.2 and Kurz et al. 2007, for a detailed description of the sampling procedure) to ensure feasibility with available resources and to address the research interests regarding a better understanding of child development and educational processes in typical configurations.

2.2.1 Sampling Regions

Bavaria and Hesse were chosen as the survey regions because of the significant differences in the school system in these two federal states. The main institutional differences relevant for the study were different cut-off dates for primary school enrollment as well as different regulations regarding the transition from primary school to secondary school, especially the relative importance of parents' will and teachers' assessment for this transition.

In both federal states, regions with comparable socioeconomic structures were selected. These were one large city (Nuremberg in Bavaria, Frankfurt a. M. in Hesse), one medium-sized city (Bamberg in Bavaria, Darmstadt in Hesse), and two rural districts (districts of Bamberg and Forchheim in Bavaria, districts of Bergstrasse and Odenwald in Hesse). These survey regions provided a wide variety of conditions for individual educational decisions, such as institutional requirements and different regional and local opportunity structures. They offered practical advantages concerning the feasibility of the study (location of the University of Bamberg, deviating legal regulations in Hesse, accessibility and cooperation with other regional research institutions).

The socioeconomic structures of the selected sample regions showed apparent urban-rural differences with regard to population density, economic structure, labor market situation, and the proportion of migrants, which persist today. There are clear differences between the two federal states with regard to the economic structure (stronger agricultural character in the Bavarian districts vs. densification in the Hessian districts) and the proportion of migrants (significantly higher in Hessian districts). Differences in the preschool and school situation in the selected counties are mainly due to the higher frequency of preschools run by the Catholic Church in all Bavarian districts (except Nuremberg). In contrast, preschools in Hesse were primarily run by local authorities. Furthermore, the proportion of migrants in Hessian preschools and schools is in some cases significantly higher; this is especially true in the cities of Frankfurt and Darmstadt.

2.2.2 Two-Stage Sampling Process

In the first step of sampling, preschools were selected in which children within a specific birth window were recruited in a second step. The population for the

first step was narrowed down using five criteria and further exclusion criteria. The stratification criteria for a targeted sample of 100 preschools and 600 children were (see Kurz et al. 2007; von Maurice et al. 2007):

- Disproportionate stratification by federal state: Bavarian and Hessian preschools in a ratio of 60 to 40.
- Disproportionate stratification of the number of study preschools by the major cities of Nuremberg and Frankfurt (33% of preschools each) and the remaining districts (67% of preschools each).
- Disproportionate stratification with respect to the proportion of migrants in the preschools from Frankfurt and Nuremberg. For this purpose, three groups of migrant shares were formed: low = preschools with less than 10% of the children, medium = preschools with 10% to less than 50%, high = preschools with 50% and more. The target was 33% of each of the three groups.
- Proportional stratification based on the number of groups in the preschools to ensure an equal probability of selection for all children regardless of the size of the preschool (see Sect. 4.1 for the description of the final sample).
- Disproportionate stratification based on the number of primary schools the target children would enroll in: For practical reasons, i.e., to ensure successful tracking of the children across institutional contexts, 90% of the sample were composed of preschools whose children regularly transfer to only one primary school. The remaining 10% consisted of preschools with three or more transitional primary schools. Thus, preschools with exactly two receiving primary schools were excluded.
- Further restrictions such as the exclusion of special needs preschools or preschools with special educational concepts (e.g., Waldorf, Montessori) to ensure better comparability of the learning conditions on the one hand and the focus on generalizable encountered institutional conditions rather than particular educational concepts on the other hand.

After applying these stratification criteria, the sampling frame consisted of 688 preschools. First, the 178 sponsors were contacted, and after their written acceptance, the institution heads and the pedagogical staff were invited to participate in the study. In the end, 97 facilities were recruited in this way. Only one group was selected from each participating preschool; often, only one group per preschool was eligible.

Only children who became of school age in the 2008/2009 school year were selected for inclusion in the study. Thus, the birth window in Bavaria was between 01.10.2001 and 31.10.2002 and in Hesse between 01.07.2001 and

30.06.2002 due to different cut-off dates for school enrollment in the two federal states. The families of the selected children were finally invited to participate. The willingness of the contacted parents to participate was relatively high, with 75% in Bavaria and 78% in Hesse, so that a sample size of altogether $n = 547$ participating target children and their families could be realized.

2.3 Sample Enhancements

After the initial sampling, the BiKS-3-18 sample was expanded at several points.

2.3.1 Refreshment

Due to previous studies on selective access to preschools at the time (cf. Fuchs 2005; Kreyenfeld 2007) and to be able to examine the effects of the duration of preschool attendance, an attempt was made from the second year of the study onward to recruit additional children who had entered preschool at a later age. Since the participation rates at preschool age were almost 90% in Germany (Autorengruppe Bildungsberichterstattung 2008), only 14 families were eligible for later inclusion. Of these families, seven children could be recruited to participate (five children in Wave 3 and two in Wave 5), resulting in a final sample of $n = 554$.

2.3.2 Returns

The main reason for sample dropouts between Waves 1 and 6 was moving families or when participating children changed preschools. At the time of primary school enrollment, all 60 families who could no longer participate in the study due to a change of preschool were contacted again. Of these, 24 returned to the study in the first grade of primary school (Wave 7).

A similar procedure was undertaken when contacting parents and children again for the assessments when children were in secondary education. It was again possible to include them due to the change of the tracking strategy (see Sect. 2.4) in this study phase. All families that did not actively withdraw their participation in the study were contacted again in 2014.

2.3.3 Class Complement Sample

The third and largest enhancement of the initial sample took place at the time of school enrollment by including the school and class context of the participating children (cf. Schmidt et al. 2009). The classmates of the previously accompanied children were added to the sample to include the class context into analyses. The following procedure was used to select the primary schools to which the children in the original sample transferred:

First, schools outside the BiKS survey regions or special types of schools (i.e., private schools, schools with a special educational concept, and special needs schools) were excluded due to insufficient case numbers, unsuitable implementation conditions, and excessive costs. This affected seven schools with a total of ten participating children.

A total of 71 schools in Bavaria and 46 schools in Hesse were contacted, of which 58 and 29 could finally be recruited, respectively. In every school, at least one class was to be included. In schools with more than one eligible class, the one with the most participating children and classes attended by at least three children from the initial sample were included.

In 142 participating classes, all classmates and their parents were invited to the study. The response rates on the class and school levels showed a large variance between the different survey regions (cf. Schmidt et al. 2009). Of the 1,403 families contacted, 528 agreed to participate, so 999 children were in the sample after this enhancement. All these children were tracked longitudinally through primary school and beyond.

2.4 Tracking Strategy

With school enrollment, school participation patterns resulted in three subgroups with different tracking and competence assessment strategies (see Fig. 2). First, if possible, all participating children of the initial sample (including Refreshment and Returns) were tracked and tested in the school and classroom context (with additional tests being presented to these children at home; see Weinert and Ebert this volume, for more details). If this was not possible, either because they attended a school with too few other study participants or because the school was unwilling to participate, the children were tracked and tested individually (see Weinert and Ebert this volume). Initially, in Wave 7, this affected 94 of the 471 remaining children of the initial sample.

In Wave 7, overall, 880 children were tracked in school context: a total of 352 children of the initial sample and 528 classmates, while 25 children were still tracked in preschools. When schools terminated participation during the study, children of the initial sample were then tracked individually; over the course of the study, this applied to 52 children. Their affected classmates were not followed up (individually) during primary school, but contacted again in Wave 11; this affected 39 children. In addition, 25 children of the initial sample who were still in preschool in Wave 7 were tracked after their enrollment either in the classroom context ($n = 12$) or individually.

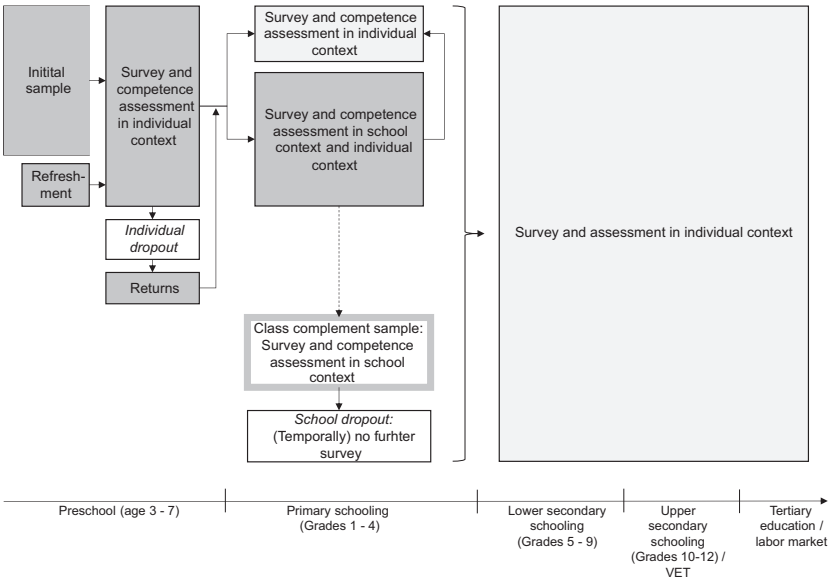

Fig. 2 Tracking strategy in BiKS-3-18

In Waves 11, 12, and 13, all participants were tracked individually. While the assessments in Waves 11 and 12 took place at home, in Wave 13, students and their parents mostly completed questionnaires online (6.3% of parents opted for a paper questionnaire). In addition to the previously individually tracked participants and those who were followed in a class context, all former participants who were not surveyed by design (i.e., students from the class complement sample whose school ended their participation or who changed (pre)schools during the first waves) were also included in this phase of the study (see Weinert et al. 2021, for details on Wave 13).

3 Sample Development

3.1 Panel Participation

In the beginning, 547 children participated in the study. This number remained relatively stable over the first six waves (see Fig. 3). Most dropouts were due

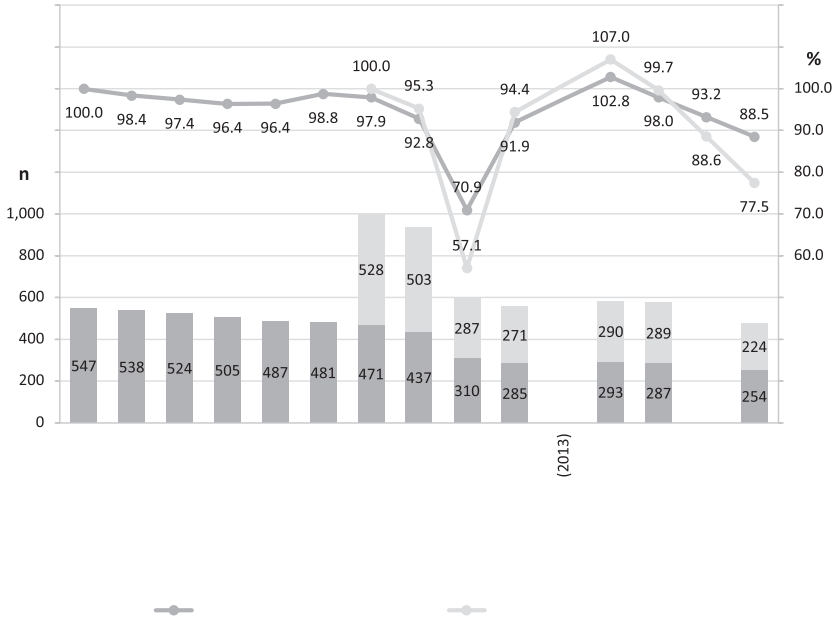

Fig. 3 Development of the BiKS-3-18 sample (absolute) and panel participation rates (in percent)

to children leaving the studied preschools, mostly because families moved for unrelated reasons. By the time most of the children would enroll in primary school in 2008, 481 children (after Wave 6) were still participating in the study, representing 87.9% of the initial sample.

After enrollment, 528 classmates joined the remaining 471 children in Wave 7. This led to a total sample size of 999 children. In the last wave of primary school (Wave 10), 285 children (52.1%) of the initial sample and 271 of their classmates (51.3%) were still participating.

After the transition into secondary schooling and due to the change in the tracking strategy, the sample increased in Wave 11 to 293 participants of the initial sample and 290 of the class complement sample. In Wave 13, 254 students (46.4%) of the initial sample and 224 classmates (42.4%) were still participating.

The BiKS-3-18 sample exhibits very high panel stability. Concerning panel participation rates[1] of the remaining participants from every wave to its respective previous wave, it is noticeable that the panel stability is consistently above 96% during preschool, i.e., up to and including Wave 6. From primary school entry onwards (between Waves 6 and 10), panel mortality increases slightly, with panel stability reaching a low of only 70.9% for children of the initial sample and 57.1% for children of the class complement sample in Wave 9. However, panel participation rates return to the original high level in the last wave at the end of primary school and stay high after the change of the study design from the point when children were in secondary schooling and onwards.

The sharp decline in panel participation in Wave 9 was attributable to the Bavarian sub-sample alone. Particularly strong effects of social origin on the probability to leave the study could be found immediately before Wave 9 for children of the class complement sample in Bavaria. This decline in panel participation was due to a mandated additional *active* panel consent procedure which was only necessary in Bavaria (due to a change in data protection law). Further analyses also showed that those families who dropped out of the study due to the non-availability of consent forms did not differ significantly in socio-demographic characteristics from those who left the study for other reasons (Homuth et al. 2017). Although panel participation rates also fell in Hesse after school entry (Waves 7 to 10), they remained consistently in the range of about 90% for children of the initial sample and the class complement sample. In Bavaria, on the other hand, panel participation rates were over 90% also after school enrollment (Waves 7 and 8). Participation dropped in Wave 9 to 66.5% for children in the initial sample and 71.2% for children of the class complement sample. While participation rates of families of the initial sample recovered slightly to 83.3% at the last wave in primary school (Wave 10), they dropped further to 60.8% for children of the class complement sample (see Homuth et al. 2017, for more information and further explanation).

3.2 Educational Trajectories

BiKS-3-18 allows analyses of students' educational trajectories from the beginning of preschool to the end of secondary education and beyond. Figure 4

[1] Panel participation rate is defined as the share of remaining gross panel sample of the gross panel sample of the respective previous panel wave. Response rates of all instruments by waves are provided in Table 3.

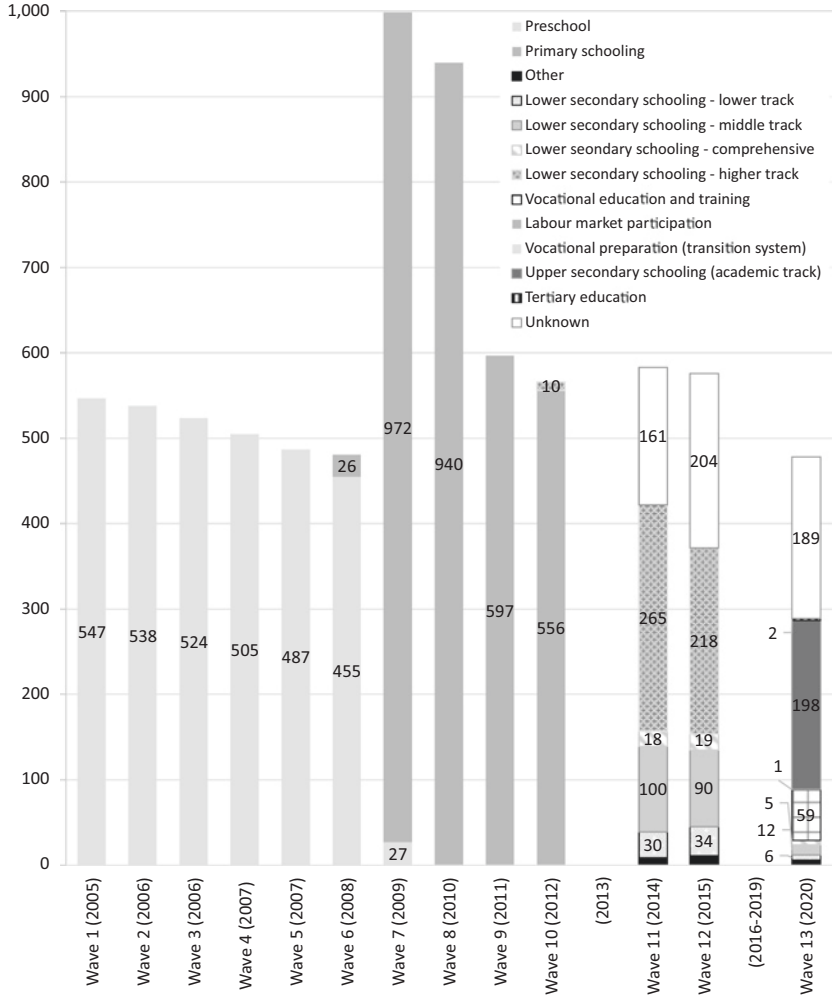

Fig. 4 Educational status of the BiKS-3-18 sample by wave

presents the educational status of the sample in each wave. During the first five waves, all children attended preschools. A small sub-sample of students (5.4%) had enrolled early in primary schools before compulsory education. In Wave 7, most of them had enrolled in primary schools, and only a minority of the initial sample (5.6%) still attended preschool (see Faust et al. 2013; Pohlmann-Rother et al. this volume).

Waves 7 to 10 cover four years of primary education for the extended sample (the initial sample plus the class complement sample). Wave 10 was the last one before students' transition into the tracked system of secondary schooling when educational trajectories usually begin to diverge in Germany. At that time, most of the sample (98.2%) attended Grade 4.

By the time of Wave 11, all participants had transitioned to lower secondary education. Most were interviewed and tested when they were in Grade 7 (around 88% of the sample). The majority (62.8%) had transitioned into the academic track (*Gymnasium*).

By the time of Wave 13, five years after Wave 12, the majority of the sample (68.5%) were in upper secondary schooling (*Gymnasiale Oberstufe*) and close to graduation. 20.4% of the sample were in VET.

Due to the change of the tracking strategy from mainly school-based tracking to individual tracking and the two-year gap between Wave 10 and Wave 11, there were quite large shares of the sample (around 25%) without available information on their current educational status due to nonresponse in Waves 11 to 13.

4 Sample Description and Selectivity

4.1 Sample Description

Selected characteristics of the BiKS-3-18 sample at different educational stages are presented in Table 1. At the beginning of the study, participating children were on average 42.2 months old. While the sex distribution was initially slightly more male-oriented (51.9%), the distribution changed over the course of the study in favor of girls, who made up 52.3% after 15 years in Wave 13. By design, regional distribution was strongly oriented towards students in Bavaria, which resulted in around two-thirds of the sample. Most children came from families with higher educated parents, with 49.3% of families where both parents had a university entrance qualification (*Abitur*). Regarding the migration background of the families, with 21.8% in Wave 1, the BiKS-3-18 sample showed slightly

Table 1 Sample description

Wave	Wave 1	Wave 6	Wave 7	Wave 10	Wave 11	Wave 13
Time	Sept. 2005	March 2008	March 2009	March 2012	May 2014	May 2020
Educational stage	1st year of preschool	3rd year of preschool	Primary school Grade 1	Primary school Grade 4	Secondary schooling Grade 7	End of secondary schooling / vocational education
Sample size	547	481	999	556	583	478
Age in months	$M = 42.2$ $SD = 4.1$	$M = 72.3$ $SD = 4.1$	$M = 84.4$ $SD = 4.7$	$M = 120.3$ $SD = 4.6$	$M = 146.2$ $SD = 4.7$	$M = 218.2$ $SD = 4.5$
Sex	51.9% male 48.1% female	50.5% male 49.5% female	47.8% male 52.5% female	46.9% male 53.1% female	48.5% male 51.5% female	47.7% male 52.3% female
Federal state	64.5% Bavaria 35.5% Hesse	64.2% Bavaria 35.8% Hesse	67.8% Bavaria 32.2% Hesse	56.7% Bavaria 43.3% Hesse	65.2% Bavaria 34.8% Hesse	67.0% Bavaria 33.0% Hesse
Socioeconomic status [a]	$M = 54.6$ $SD = 15.4$	$M = 55.1$ $SD = 15.5$	$M = 54.6$ $SD = 15.2$	$M = 55.8$ $SD = 15.2$	$M = 55.8$ $SD = 14.7$	$M = 54.5$ $SD = 15.8$
Parental general education [b]						
Lower secondary [quali. Hauptschule]	18.3%	18.2%	17.1%	11.6%	12.9%	16.5%
Medium secondary [Mittlere Reife]	32.4%	31.9%	32.2%	33.3%	33.1%	34.8%
University admission [Fach-/Abitur]	49.3%	49.9%	50.8%	55.1%	54.0%	48.7%

(continued)

Table 1 (continued)

Wave	Wave 1	Wave 6	Wave 7	Wave 10	Wave 11	Wave 13
Migration background [c]	78.2%	79.4%	78.4%	80.0%	78.3%	75.1%
Without migration background At least one parent with another mother tongue than German	21.8%	20.6%	21.6%	20.0%	21.7%	24.9%

Notes: [a] Measured in the family's highest International Socio-Economic Index of Occupational Status (HISEI; Ganzeboom et al. 1992). Highest value over all panel waves; rate of missing values = 5.3%. [b] Highest value over all panel waves; rate of missing values = 6.8%. [c] Rate of missing information = 3.3%.

fewer migrants than would be expected from the overall distribution in Germany in 2005 with up to around 32% (Destatis 2017).[2]

4.2 Sample Attrition and Selectivity

When considering the sample dropout, the question arises whether the dropouts are neutral with respect to central sample indicators. Overall, there generally was no particular selectivity in sample attrition. The differences found are within the range expected in longitudinal studies (Table A1 in the Appendix provides the results of regression analyses of the participation for each panel wave). Overall sample attrition was less pronounced during the preschool years than during the school years. The single exception was the selective dropout in the Bavarian subsample due to the exogenous shock of the law change (see Sect. 3.1).

As expected from longitudinal studies (Rendtel 1995), participating families usually have a higher socioeconomic status and higher educational qualifications than non-participants. Compared to the children in the initial sample, these differences are somewhat more pronounced for children of the class complement sample, especially for the probability of dropout by familial socioeconomic status.

However, a closer look reveals that significant socially selective dropout occurred only at two certain stages of the study. First, for the children of the initial sample, selective dropouts occurred primarily at Wave 5. In general, dropouts in the preschool period (Waves 1 to 6) were mainly due to preschool changes or when families moved out of the study regions. One plausible explanation for the social selectivity of these dropouts could be that such changes might occur more frequently in facilities with special support services and thus, tend to affect children from lower social strata or educationally disadvantaged families (Autorengruppe Bildungsberichterstattung 2014).

Second, in the last two survey waves during primary school (Waves 9 and 10), significant socially selective dropouts occurred, especially for the participants

[2] Children were here defined as migrants if one or both parents had a non-German mother tongue. This definition is very likely to be an underestimation compared to the definition of the Mikrozensus, which is based on the family members' countries of birth. We chose this definition because of the significantly higher share of missing information on countries of origin for both parents (13.3% vs. 3.3%). Using the country-of-origin definition, 24.0% of the BiKS-3-18 sample have a migration background. The correlation between these two measures is $r_s = .87$.

of the class complement sample. On the one hand, this can be explained by the mandated additional active panel consent procedure, which was only necessary in Bavaria, and on the other hand, by the upcoming transition from primary into secondary school, which puts families under pressure and resulted in higher drop-outs.

Measured by the parents' highest educational attainment in the overall sample, there was no systematic correlation between school-leaving qualifications and dropout probability within the first six waves (preschool period). Only in Waves 5 and 9, there was a significant correlation between the parents' highest educational attainment and participation. However, this can only be observed in Bavaria, not in Hesse. The causes are the same as those described above.

The development of the total sample concerning the migration background of the children did not show any particular anomalies. At the beginning of the study (Wave 1), 21.8% of the sample had at least one parent whose mother tongue was not German. At the beginning of the school years (Wave 7), this figure was 21.6%, and at the end of primary schooling (Wave 10), 20.0% of the sample. These slight changes can also be attributed to the Bavarian sub-sample, in which the share of children with a migration background decreased by 4.8 percentage points from Wave 1 to Wave 10 while the share of migrants in the Hessian sub-sample remained stable over the same period.

5 Contents of the Study

5.1 Instruments and Measurement Times

The BiKS-3-18 longitudinal study is characterized by the parallel investigation of child development in different contexts, which resulted in the use of many data collection instruments in different modes (cf. Table 2). On the one hand, child development was continuously measured through standardized tests and assessments in individual or group settings in various developmental domains (see Weinert and Ebert this volume, for further information). On the other hand, the learning environments in the family and in institutions (preschool and primary school) were also examined using questioning and observation procedures (see Rossbach et al. this volume, for further information). Next to the children, parents were the most important participants for the longest time of the study. They were contact persons and provided information on children's familial development and learning context (as well as on developing child characteristics).

Table 2 Overview of instruments

Target / Instrument	Waves	Mode	Contents
Children			
Student questionnaire	9–13	PAPI, CAWI	Students' attitudes toward school, learning, motivation, socio-emotional skills, life satisfaction, language use, and information on their home learning environment
Standardized assessment of child development (individual setting)	1–13	DA, PBA, TBA	Standardized assessment of domain-specific and domain-general development in the (meta-)cognitive and language area, e.g., vocabulary, grammar, text comprehension, nonverbal cognition, mathematical competencies, factual and common knowledge
Standardized assessment of child development (group setting)	7–10	PBA	Competencies measurement in a classroom setting in various domains, including nonverbal cognition, language, reading, mathematics
Parents and family			
Parent questionnaire including child-related assessment sheet	1–13	PAPI, CAWI	Judgements of various child characteristics, interests, strengths, including motivational and socio-emotional aspects, and judgements of the educational institutions attended by the child
Family activity list	2–10	PAPI	Daily activities in the family
Parent interview	1–12	CAPI, CATI	Housing situation, the family's financial situation, the child care history, experiences with preschool, the family's endowment with cultural capital, everyday family life, child-rearing and educational attitudes, aspects of the child's social-emotional behavior, his/her development, and the child's goals or educational aspirations of the parents for the child are recorded
Process monitoring in the family	1–10	OLR	Semi-standardized tasks to capture global and domain-specific stimulation quality within families

(continued)

Table 2 (continued)

Target / Instrument	Waves	Mode	Contents
Parental competence assessment	11–13	DA, TBA	Indicator of parent vocabulary, verbal fluency, common knowledge
Preschool teachers and heads			
Teacher questionnaire	1–6	PAPI	Preschool-specific characteristics, including both structural and process-related characteristics as well as personal characteristics of the teachers (e.g., training and attitudes)
Child-related assessment sheet	1–7	PAPI	Assessments of preschool teacher's judgement of various child abilities and characteristics, including motivation and social-emotional facets
Preschool activities list	2–6	PAPI	Daily activities in the preschool on group level
Head questionnaire	1–5	PAPI	Structural aspects of the preschool and their usage, training and attitudes of the heads, the goals and guidelines of the preschool's educational work
Process monitoring in preschools	2–6	OLR	Structural features, assessment of teacher–child interaction, global and domain-specific stimulation quality at the group level
Target child monitoring	2–6	OLR	Assessment of global and domain-specific learning quality at the child level (teacher support and child activities)
Primary school teachers and heads			
Class teacher questionnaire	7–10	PAPI	Structural and teachers' personal characteristics (e.g., education and attitudes) on the class level
Child-related assessment sheet	7–10	PAPI	Teacher judgements of child characteristics, including e.g., child abilities, motivation, social-emotional characteristics
Classroom lesson diary	7-9a	PAPI	Lesson design, progress, and corresponding student behavior

(continued)

Table 2 (continued)

Target / Instrument	Waves	Mode	Contents
Head questionnaire	8	PAPI	Structural aspects of the school and their use, as well as issues related to training and attitudes of the school's leadership towards goals and guidelines of instructional design
Process monitoring in primary schools	7a-9a	OLR	Classroom observation with a live rating of teacher-student interaction and learning atmosphere as well as audio recording of teacher language

Notes: Listed contents represent the main topics of the instruments over all waves and not all contents were measured in all listed waves. CAPI = Computer-assisted personal interview. CATI = Computer-assisted telephone interview. CAWI = Computer-assisted web interview. OLR = Direct observation and live rating by an interviewer. PBA = Paper-based assessment. PAPI = Paper and pencil interview. DA = Direct assessment. TBA = Technology based assessment

The combination of different and very complex research methods enables complex questions to be addressed about the conditions of child development at preschool and school age. During the preschool and primary school phase, several survey, testing, and observational instruments were used. In later waves, i.e., during and beyond the secondary school and VET phases, only survey and testing instruments, though no observational instruments were employed.

In addition, to study the formation and probation of decisions about the time of school enrollment, i.e., if a child would be enrolled early at a younger age, at the regular time given by the different state laws, or one year later, BiKS-3-18 included qualitative instruments for mixed-methods-analyses (see Kratzmann et al. 2012; Pohlmann-Rother et al. this volume). This design included semi-standardized face-to-face interviews with parents, preschool teachers, and primary school heads. Parents were asked about their attitudes and expectations towards the time of enrollment into primary school and the probation of the decision made. The interviews with preschool heads addressed procedures for untimely enrollment and experiences of school heads as well as their understanding of school readiness. Primary school heads were asked about their attitudes towards school enrollment dates, perceptions of school readiness, and expected demands of school for school beginners, as well as the cooperation of selected preschool teachers with primary schools.

5.2 Realization of the Measurement Points and Response Rates

Response rates were unevenly distributed across the instruments used (see Table 3). In the case of the standardized assessments of children's competencies, rates of between 84 and 98% were consistently achieved. Response rates for survey instruments such as child-related assessment sheets, questionnaires, or activity lists for preschool and primary school teachers, and families proved to be much lower (as low as 38%). Some of these instruments are very comprehensive and time-consuming. The lower response rates compared to the standardized tests on children's domain-specific and domain-general development in the (meta-) cognitive and language area are mainly based on the more limited possibilities to control the data collection context by the project team (paper self-questionnaire for teachers vs. standardized live rating).

Competence assessments in the sub-sample that was individually tracked during primary school were performed at the students' homes. This was possible because families of the initial sample were visited for the assessment of learning situations at home anyway; therefore, all children of the initial sample were additionally presented with standardized tests that afforded an individual test setting and had already been administrated at preschool age (see Weinert and Ebert this volume, for an in-depth overview).

6 Research Potentials of BiKS-3-18

The BiKS-3-18 study offers a broad dataset that allows high-quality empirical education research within the German education system from an interdisciplinary perspective. Therefore, the BiKS study has contributed and will contribute substantially to a better understanding of children's education-related development and of the effects of various learning environments on a range of cognitive and so-called "non-cognitive" outcomes as well as on the development and interrelations of both kinds of outcomes. This is possible as the BiKS-3-18 study is a longitudinal study including repeated information on different competencies and skills from various informants. Amongst others, the availability of a range of explanatory factors and outcomes allows to investigate which outcomes are

Table 3 Response rates by instruments and waves

Wave	Instrument	Mode	Sample size	Valids [a]	Response (rate)
Wave 1	Competence assessment	PBA	547	535	97.8%
	Parent interview	CAPI	547	547	100.0%
	Parent questionnaire	PAPI	547	442	80.8%
	Process monitoring in the family	OLR	547	543	99.3%
	Preschool teacher questionnaire	PAPI	547	540	98.7%
	Preschool head questionnaire	PAPI	547	547	100.0%
	Child-related assessment sheet	PAPI	547	502	91.8%
Wave 2	Competence assessment [c]	PBA	257	252	98.1%
	Parent questionnaire	PAPI	538	358	66.5%
	Family activity list	PAPI	538	292	54.3%
	Preschool teacher questionnaire	PAPI	538	480	89.2%
	Child-related assessment sheet	PAPI	538	429	79.7%
	Preschool activities list	PAPI	538	452	84.0%
	Process monitoring in preschools	OLR	538	535	99.4%
	Target child monitoring [b]	OLR	102	102	100.0%
Wave 3	Competence assessment	PBA	524	517	98.7%
	Parent interview	CATI	524	501	95.6%
	Parent questionnaire	PAPI	524	335	63.9%
	Family activity list	PAPI	524	285	54.4%
	Process monitoring in the family	OLR	524	415	79.2%
	Preschool teacher questionnaire	PAPI	524	520	99.2%
	Preschool head questionnaire	PAPI	524	464	88.6%
	Child-related assessment sheet	PAPI	524	449	85.7%
	Preschool activities list	PAPI	524	323	61.6%
	Process monitoring in preschools	OLR	524	301	57.4%
	Target child monitoring [b]	OLR	102	98	96.1%
Wave 4	Competence assessment [c]	PBA	257	235	91.4%
	Parent questionnaire	PAPI	505	373	73.9%
	Preschool teacher questionnaire	PAPI	505	455	90.1%
	Child-related assessment sheet	PAPI	505	448	88.7%
	Process monitoring in preschools	OLR	505	491	97.2%
	Target child monitoring [b]	OLR	102	98	96.1%

(continued)

Table 3 (continued)

Wave	Instrument	Mode	Sample size	Valids [a]	Response (rate)
Wave 5	Competence assessment	PBA	487	453	93.0%
	Parent questionnaire	PAPI	487	301	61.8%
	Parent interview	CATI	487	437	89.7%
	Process monitoring in the family	OLR	487	432	88.7%
	Family activity list	PAPI	487	273	56.1%
	Preschool teacher questionnaire	PAPI	487	465	95.5%
	Preschool head questionnaire	PAPI	487	375	77.0%
	Child-related assessment sheet	PAPI	487	390	80.1%
	Preschool activities list	PAPI	487	363	74.5%
	Process monitoring in preschools	OLR	487	265	54.4%
	Target child monitoring [b]	OLR	102	94	92.2%
Wave 6	Competence assessment	PBA	481	434	90.2%
	Parent questionnaire	PAPI	481	319	66.3%
	Parent interview [d]	CATI	26	20	76.9%
	Family activity list	PAPI	481	293	60.9%
	Preschool teacher questionnaire	PAPI	481	428	89.0%
	Child-related assessment sheet	PAPI	481	388	80.7%
	Preschool activities list	PAPI	481	340	70.7%
	Process monitoring in preschools	OLR	481	461	95.8%
	Target child monitoring [b]	OLR	102	94	92.2%
	Primary class teacher questionnaire [d]	PAPI	26	19	73.1%
Wave 6a	Child-related assessment sheet [e]	PAPI	27	19	70.4%
	Parent questionnaire	PAPI	1,021	338	33.1%
Wave 7	Competence assessment (individual) [f]	PBA	471	414	87.9%
	Competence assessment (group)	PBA	999	887	88.8%
	Parent questionnaire [f]	PAPI	471	269	57.1%
	Parent interview	CATI	999	887	88.8%
	Family activity list [f]	PAPI	471	247	52.4%
	Process monitoring in the family [f]	OLR	471	407	86.4%
	Child-related assessment sheet [e]	PAPI	27	16	59.3%
	Class teacher questionnaire	PAPI	999	640	64.1%
	Classroom lesson diary	PAPI	999	661	66.2%

(continued)

Table 3 (continued)

Wave	Instrument	Mode	Sample size	Valids [a]	Response (rate)
Wave 7a	Parent questionnaire [h]	PAPI	21	15	71.4%
	Class teacher questionnaire [g]	PAPI	23	12	52.2%
	Process monitoring in primary schools	OLR	945	700	74.1%
Wave 8	Competence assessment (individual) [f]	PBA	437	326	74.6%
	Competence assessment (group)	PBA	940	737	78.4%
	Parent questionnaire [f]	PAPI	437	186	42.6%
	Parent interview	CATI	940	801	85.2%
	Family activity list [f]	PAPI	437	191	46.4%
	Process monitoring in the family [f]	OLR	437	329	75.1%
	Class teacher questionnaire	PAPI	940	510	54.3%
	Process monitoring in primary schools	OLR	940	684	72.8%
	Child-related assessment sheet [i]	PAPI	896	506	56.5%
	Classroom lesson diary	PAPI	940	446	47.5%
	Head questionnaire	PAPI	940	623	66.3%
Wave 8a	Class teacher questionnaire [g]	PAPI	891	246	27.6%
	Classroom lesson diary	PAPI	891	303	34.0%
	Process monitoring in primary schools	OLR	891	513	57.6%
Wave 9	Student questionnaire	PAPI	597	358	60.0%
	Competence assessment (individual) [f]	PBA	310	272	87.7%
	Competence assessment (group)	PBA	597	444	74.4%
	Parent questionnaire [f]	PAPI	310	174	56.1%
	Parent interview	CATI	597	456	76.4%
	Family activity list [f]	PAPI	310	161	51.9%
	Process monitoring in the family [f]	OLR	310	273	8.6%
	Class teacher questionnaire	PAPI	597	282	47.2%
	Child-related assessment sheet	PAPI	597	279	46.7%
Wave 9a	Class teacher questionnaire [g]	PAPI	185	51	27.6%
	Classroom lesson diary	PAPI	680	228	33.5%
	Process monitoring in primary schools	OLR	680	358	52.7%

(continued)

Table 3 (continued)

Wave	Instrument	Mode	Sample size	Valids [a]	Response (rate)
Wave 10	Student questionnaire	PAPI	556	394	70.9%
	Competence assessment (individual) [f]	PBA	285	248	87.0%
	Competence assessment (group)	PBA	556	494	88.9%
	Parent questionnaire [f]	PAPI	285	155	54.4%
	Parent interview	CATI	556	446	80.2%
	Family activity list [f]	PAPI	285	149	52.3%
	Process monitoring in the family [f]	OLR	285	246	86.3%
	Class teacher questionnaire	PAPI	556	286	51.4%
	Child-related assessment sheet	PAPI	556	293	52.7%
Wave 11	Student questionnaire	PAPI	583	406	69.6%
	Competence assessment	PBA	583	434	74.4%
	Parent questionnaire	PAPI	583	408	70.0%
	Parent interview	CATI	583	469	80.5%
	Parental competence assessment	PBA	583	414	71.0%
Wave 12	Student questionnaire	PAPI	576	166	28.8%
	Competence assessment	PBA	576	447	77.6%
	Parent questionnaire	PAPI	576	164	28.5%
	Parent interview	CATI	576	446	77.4%
	Parental competence assessment	PBA	576	414	71.9%
Wave 13	Student questionnaire	CAWI	478	289	60.5%
	Student competence assessment	TBA	478	259	54.2%
	Parent questionnaire	CAWI	478	320	66.9%
	Parent competence assessment	TBA	478	239	50.0%

Notes: [a] The numbers for instruments on the class or school level relate to the number of children for whom at least one valid instrument is available. [b] Only for a sub-sample of children. [c] Only for a sub-sample of children in Bavaria. [d] Only for early enrolled children. [e] Only for children who were not enrolled in primary school. [f] Only administered to/completed for children from the initial sample (including refreshment and returns). [g] This questionnaire contained basic information about teachers and was completed by teachers only once. [h] Only for late-enrolled children. [i] Only for children who enrolled regularly

affected by common and specific factors in different phases of child development (the *complementarity principle* and/or *the specificity principle* in child development; Bornstein 2019; Malti and Cheah 2021).

Data of the BiKS-3-18 study are available to researchers on request at the Research Data Centre of the Institute of Quality Development at the Humboldt-Universität zu Berlin (FDZ at IQB). Furthermore, on the Website of the FDZ at IQB, a list of publications using the data of the BiKS-3-18 study is available. Publications in this volume provide an overview over the most investigated topics within the BiKS-3-18 study available to date.

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Appendix

See (Table A1).

Table A1 Explaining continued participation in the study

Wave	2	3	4	5	6	7	8	9	10	11	12	13
Sex: Female (Ref. Male)												
	0.012	0.045	0.019	0.072	0.000	0.044	0.001	0.020	−0.013	−0.032	−0.033	0.076
	(0.012)	(0.016)	(0.017)	(0.016)	(0.009)	(0.024)	(0.014)	(0.031)	(0.020)	(0.038)	(0.038)	(0.044)
Age in months												
	0.055	0.010	0.014	−0.046	0.112	0.020	0.021	−0.085*	−0.032	−0.039	−0.042	−0.003
	(0.001)	(0.002)	(0.002)	(0.002)	(0.001)	(0.003)	(0.001)	(0.003)	(0.002)	(0.004)	(0.004)	(0.005)
Federal state: Hesse (Ref. Bavaria)												
	−0.058	0.049	−0.014	0.069	−0.065	0.029	0.032	0.325***	−0.031	−0.090	−0.090	−0.031
	(0.015)	(0.018)	(0.021)	(0.015)	(0.013)	(0.026)	(0.013)	(0.031)	(0.022)	(0.043)	(0.043)	(0.048)
HISEI[a]												
	0.045	0.055	−0.048	0.141*	0.024	−0.044	−0.008	−0.054	0.062	0.004	−0.030	0.077
	(0.001)	(0.001)	(0.001)	(0.001)	(0.000)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.002)
Highest parental education (Ref. University admission [Fach-/Abitur])												
Lower secondary [quali. Hauptschule]	0.009	0.046	−0.035	0.105	0.050	0.034	−0.097	−0.171***	−0.069	−0.062	−0.084	0.011
	(0.033)	(0.029)	(0.029)	(0.028)	(0.011)	(0.038)	(0.027)	(0.053)	(0.048)	(0.074)	(0.073)	(0.085)

(continued)

Table A1 (continued)

Wave	2	3	4	5	6	7	8	9	10	11	12	13
Medium secondary [Mittlere Reife]	0.048	−0.068	−0.040	0.130*	−0.019	−0.086	-0.023	−0.079*	0.020	0.004	−0.021	0.079
	(0.022)	(0.024)	(0.018)	(0.022)	(0.015)	(0.035)	(0.015)	(0.039)	(0.028)	(0.046)	(0.044)	(0.054)
Migration background: Yes (Ref. No)												
	0.042	−0.097	−0.076	0.048	−0.016	−0.027	0.021	−0.092**	0.076	0.040	0.036	0.109*
	(0.015)	(0.029)	(0.029)	(0.019)	(0.013)	(0.032)	(0.016)	(0.039)	(0.025)	(0.050)	(0.049)	(0.058)
N	474	465	453	438	427	423	841	805	548	517	517	517

Note. Standardized linear beta coefficients; standard errors in parentheses. N refer to previous waves. [a] Highest International Socio-Economic Index of Occupational Status

* $p<0.05$, ** $p<.01$, *** $p<.001$

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