University of Groningen

Longitudinal effects of induction on teaching skills and attrition rates of beginning teacher

Helms-Lorenz, Michelle; van de Grift, Wim; Maulana, Ridwan

Published in:
School Effectiveness and School Improvement

DOI:
[10.1080/09243453.2015.1035731](https://doi.org/10.1080/09243453.2015.1035731)

IMPORTANT NOTE: You are advised to consult the publisher's version (publisher's PDF) if you wish to cite from it. Please check the document version below.

Document Version
Publisher's PDF, also known as Version of record

Publication date:
2016

[Link to publication in University of Groningen/UMCG research database](#)

Citation for published version (APA):

Helms-Lorenz, M., van de Grift, W., & Maulana, R. (2016). Longitudinal effects of induction on teaching skills and attrition rates of beginning teacher. *School Effectiveness and School Improvement*, 27(2), 178-204. <https://doi.org/10.1080/09243453.2015.1035731>

Copyright

Other than for strictly personal use, it is not permitted to download or to forward/distribute the text or part of it without the consent of the author(s) and/or copyright holder(s), unless the work is under an open content license (like Creative Commons).

The publication may also be distributed here under the terms of Article 25fa of the Dutch Copyright Act, indicated by the "Taverne" license. More information can be found on the University of Groningen website: <https://www.rug.nl/library/open-access/self-archiving-pure/taverne-amendment>.

Take-down policy

If you believe that this document breaches copyright please contact us providing details, and we will remove access to the work immediately and investigate your claim.

Downloaded from the University of Groningen/UMCG research database (Pure): <http://www.rug.nl/research/portal>. For technical reasons the number of authors shown on this cover page is limited to 10 maximum.

Longitudinal effects of induction on teaching skills and attrition rates of beginning teachers

Michelle Helms-Lorenz*, Wim van de Grift and Ridwan Maulana

Department of Teacher Education, University of Groningen, Groningen, The Netherlands

(Received 14 September 2014; final version received 23 March 2015)

The teaching profession faces a shortage as well as a decline of teaching skills. A possible way to mitigate this is to implement evidence-based induction arrangements. Seventy-one schools with 338 beginning secondary education teachers were randomly allocated to an experimental or a control group. The experimental schools used induction arrangements; the authors measured the effects of these arrangements by using repeated lesson observations and by comparing the rates at which beginners in the control and experimental groups left the teaching profession. Three years later, 14% of the control group and 12% of the experimental group had left. Leaving the profession could be explained by a lack of certification and low initial teaching skill levels. The experimental group exhibited greater improvement in teaching skills compared to the control group. Workload reduction influenced the skill level negatively, and coaching and observing had a strong positive influence on the skill level in Year 3.

Keywords: beginning teachers; retention; induction effects; teaching skills; certification

Introduction

As in many north European countries, The Netherlands has an aging teacher population. It is estimated that by 2016, 36% of the most experienced teachers will leave the profession, to be replaced by approximately 10% beginning teachers. This skewed distribution of teacher age is evident in other nations as well, such as the Czech Republic, Estonia, Finland, Germany, Iceland, Italy, and Norway (Organisation for Economic Co-operation and Development, 2012), causing pressing teacher shortages in these countries. Teacher shortages can be a demographic artifact, caused by trends of massive population growth (baby boom), followed by lowered birth rates. Smith and Ingersoll (2004) and Algozzine, Gretes, Queen, and Cowan-Hathcock (2007) report the same problem in the United States: More teachers are leaving than entering the profession. Ideally, beginning teachers would outnumber pensioners, not only to replace retiring teachers but also to offset the 25% to 40% turnover among beginning teachers within 5 years (Smith & Ingersoll, 2004). Several studies in The Netherlands substantiate that 25% of beginning teachers leave their first teaching job within 5 years (CentERdata, 2013; retention studies conducted in other countries report even higher percentages (Alliance for Excellent Education, 2004; Danielson, 2002; Ingersoll & Smith, 2003).

An additional problem linked to the aging teacher population is that the beginning teachers, who are required to fill the growing gap, reveal less developed teaching skills (Van de Grift, 2010). As beginning teachers replace experienced teachers, the average

---

*Corresponding author. Email: m.helms-lorenz@rug.nl

quality of teaching inevitably decreases. Van de Grift's study (2010) revealed that beginning teachers display lower levels of teaching skills (66% of a standard deviation) compared to the average teacher. This difference is even more pronounced (full standard deviation) when the skill level of beginning teachers is compared with that of teachers with 15 to 20 years of experience who demonstrate the highest teaching skill levels. Replacing experienced teachers with beginning teachers thus is likely to lead to a reduction in skill in the overall teacher population for some time. This could reduce the national achievement levels of students.

Students of teachers whose teaching skills are one standard deviation higher than the average show 10% to 25% greater learning gains (Aaronson, Barrow, & Sander, 2007; Bosker & Witziers, 1996; Brandsma & Knuver, 1989; Hanushek & Rivkin, 2010; Kane & Staiger, 2008; Rivkin, Hanushek, & Kain, 2005; Rockoff, 2004; Roeleveld, 2003; Wijnstra, Ouwens, & Béguin, 2003). On the flip side, a drop in teaching skills is likely to lower student achievement levels. This phenomenon points to the importance of developing effective teaching skills during novice teachers' first few years on the job. The education economist Hanushek (2011) calculated that pupils of teachers who performed one standard deviation below the average teacher later earned an average of \$20,000 less in yearly wages, highlighting the economic repercussions of a drop in teaching skills on a national level.

This anticipated decline in teaching quality might be addressed by emphasizing and practicing effective teacher behavior during teacher education and by creating comprehensive induction support for teachers as soon as they enter the profession. Therefore, the central questions of this study are as follows: Can early attrition be reduced? Can the growth of teaching skills be accelerated during the first years of teaching? Finding evidence-based indicators and guidelines is necessary to establish the credibility of educational policy and funding practices. Furthermore, the scientific teaching community would be aided by a better understanding of the factors influencing retention and teacher growth, to develop teacher growth and retention theories. This knowledge can increase teaching quality, which eventually should positively influence students' learning.

Problems faced by beginning teachers

Reasons for early attrition from the teaching profession have been studied frequently and for decades (Créton & Wubbels, 1984; De Jonge & De Muijnck, 2002; Houtveen, Versloot, & Groenen, 2006; Van Kregten & Moerkamp, 2004; Veenman, 1984; Vonk, 1982). It is a great concern that problems identified in the 1980s still wait to be addressed in the 2010s: maintaining discipline, motivating pupils, dealing with differences between pupils, dealing with individual problematic pupils, assessing performance, handling heavy workloads, coping with colleagues and performing with insufficient resources. Houtveen et al. (2006) noted that almost 60% of former teachers declared that heavy workloads or dissatisfaction with school management and policy had led them to leave the profession. Lack of supervision, support, and cooperation with colleagues also play major roles. Thus, in addition to beginning teachers' skill level, lack of sensitivity of the environment of their first workplace can be detrimental to the longevity of their teaching careers.

Teaching research reveals a wide range of reasons for early attrition, including the pursuit of a better career; job dissatisfaction; lack of curricular support; absence of peer support networks; inadequate initial preparation; overly challenging teaching assignments; multiple class preparations; being assigned to teach low-performing students; not being given professional support, feedback, or demonstrations of what it takes to be an effective

teacher; lack of emotional support or communication; no support in learning school procedures and policies; not being able to use effective teaching strategies; and the inability to plan and manage time effectively (Alliance for Excellent Education, 2004; Andrews, Gilbert, & Martin, 2007; Brock & Grady, 1997; Danielson, 2002; Darling-Hammond, 2003; Ingersoll & Smith, 2003). In summary, some certified beginning teachers need a great deal of support, and others need it to a lesser extent. School leaders and colleagues might be convinced that certified teachers should not need this support or believe these issues should have been settled and developed before certification. However, on average, teacher education is often too short to develop all the necessary skills for an independent career start (Stevens, 2004).

Teacher induction

As the reasons for attrition and concerns of beginning teachers have become known, countries have begun to develop induction arrangements. It is not uncommon to offer new employees in other professions, such as advocates and management trainees, “early career support programs”. Professionals must learn a great deal of knowledge and many skills at the beginning of their careers, and they are expected to continue their professional development throughout their careers. As with other professions, teaching skill development should be viewed as a gradual process, with induction as a logical continuation of teacher education. Teacher induction programs can be defined as a more or less planned and formalized arrangement in which beginning teachers are assisted and supported in becoming competent and effective professionals. Wong (2004) defines induction as a process of comprehensive, coherent, and sustained professional development aimed to train, support, and retain new teachers; it represents the first part of a lifelong professional development program. Huling-Austin (1990) defines induction as “a planned program intended to provide some systematic and sustained assistance specifically to beginning teachers for at least one school year” (p. 536). Fideler and Haselkorn (1999) explain that induction programs “are designed to support, assist, train and assess teachers within the first three years of employment in public school” (p. 13).

Teacher induction is widely used to attract beginning teachers and increase their commitment to the profession. In their conceptual review of new teacher induction literature, Feiman-Nemser, Schwille, Carver, and Yusko (1999) examined three meanings associated with induction: as a phase in learning to teach, a process of teacher socialization, and a program for beginning teachers. As Feiman-Nemser et al. argue, teacher induction is “a program [that] suggests something formal and deliberate. It invokes such descriptive analytic categories as goals, curriculum, organizational structure, staff, clients, funding and evaluation” (p. 20).

As each school develops its own induction arrangement, the proverbial wheel gets reinvented over and over again, resulting in common aspects of programs but also in differences. This differentiation complicates the comparability of arrangements for research and policy purposes. There are also differences on a national level. In some countries, induction programs are nationwide systems; in others, they are more regional endeavors. Most studies reveal the following main ingredients of induction arrangements: workload reduction, school enculturation, working with professional development plans, observation in the classroom, and coaching/mentoring on the job.

Effects of induction programs

The evaluation of beginning teacher support is a popular area for research. Most studies focus on evaluating participants in the intervention. For example, Ingersoll and Strong (2011) critically reviewed 15 studies on the impact of induction and mentoring programs for beginning teachers, using evaluative studies of induction that compare outcome data from both participants and nonparticipants in particular induction components. They concluded that most studies provide empirical support for the claim that assistance for beginning teachers has positive effects on three sets of outcomes: teacher commitment and retention, classroom instructional practice, and student achievement. The authors added that all 15 reviewed studies had more or less serious limitations, though the results point in consistent directions. An important, large-scale, longitudinal, randomized trial study in primary education (Glazerman et al., 2010) revealed mixed results: no retention effects, no teacher performance effects, and positive student performance effects.

Closer examination of these retention effect studies reveals that the operationalization of retention as a construct varies from study to study. Kapadia, Coca, and Easton (2007) and Duke, Karson, and Wheeler (2006) measured teachers' intentions to stay but did not confirm whether self-reported intentions are strongly related to actual attrition. Most likely it mirrors the teachers' degree of commitment and job satisfaction rather than their longevity per se (Strong, Gargani, & Hacifazlioglu, 2011). Helms-Lorenz, Slof, and Van de Grift (2013) found an attrition rate of 10% in an experimental group and 17% in the control group after 1 year. However, these analyses did not take job switching into account. Fuller (2003), Cohen and Fuller (2006), and Smith and Ingersoll (2004) retrieved retention measures from state databases. The reliability of such databases depends to a great extent on administration discipline. The quality of data of this type is generally lower than that of data collected for research purposes, simply because they are used for policy-making purposes (e.g., such as funding decisions); schools might be reluctant to reveal true figures because doing so might damage their own interests.

Another concern with regard to the retention variable is possible confounding factors; teachers removed from a state database might not leave the profession but rather join another school (school switching) or take a break and return later. State databases may not account for these factors, in which case they would underestimate retention rates (i.e., overestimate attrition rates). Lindqvist, Norddänger, and Carlson's (2014) longitudinal study of teaching career trajectories indicates that in many cases dropouts are temporary. They advise caution in the interpretation of attrition rates due to the complex nature of the phenomenon. A more precise study with exit interviews of teachers leaving their first job reveals that not all beginning teachers who leave actually stop teaching. Smith and Ingersoll's (2004) large-scale survey study comprises a sample of 3235 beginning teachers. The survey included items designed to elicit information on the range of possible induction and mentoring supports. The authors linked these data to a teacher follow-up survey, which included all teacher turnover or departures, including those who moved to teaching jobs in other schools ("switchers") and those who left the occupation all together ("leavers"). The large-scale study statistically controlled for various teacher and school characteristics. Their central research question was whether receiving support mattered for teacher retention. Using multinomial logistic regression analyses, they found support for the negative association between receiving support and the likelihood that beginning teachers might move or leave after the end of their 1st year on the job. The strongest contributions were having a mentor from the same field, having common planning time with other

teachers in the same subject, having regularly scheduled collaboration with other teachers, and being part of an external network of teachers. The weakest factors were a reduced teaching schedule, fewer preparations, and extra classroom assistance. Furthermore, they found that as the number of components in the packages increased, both the number of teachers receiving the package and the probability of their turnover decreased. To our knowledge, no other studies of the effects of elements of induction arrangements have been conducted. This leads to our first research question: Which induction elements affect retention and teaching practice?

Study design

The aim of the current study is to fill some research gaps regarding the effects of induction arrangements. To this end, we conducted a longitudinal experiment in a secondary educational setting, which few extant studies have addressed to date. We clearly distinguish job switching and job leaving to clarify the attrition definition and operationalization haziness.

Research questions

- (1) Can beginning teacher retention be increased by induction interventions? To answer this question, attrition is unraveled by splitting the school leavers into two groups: the school switchers and the teaching profession leavers. Additionally, the influence of teacher background factors on staying are explored.
  - (a) To what extent is attrition a problem in Dutch secondary schools?
  - (b) Are beginning teachers who followed induction programs more likely to stay in their school?
  - (c) Does teaching skill level at the start affect the likelihood to stay in their school?
  - (d) Does certification affect the likelihood to stay in their school?
- (2) Are beginning teaching skills (of the stayers) in Year 3 influenced by induction interventions (workload reduction, enculturation, professional plans, coaching, and observing)? To answer this question, the influence of teacher background factors and induction interventions on teaching skills in Year 3 of stayers are explored.
  - (a) Does the teaching skill level at the start affect the teaching skill level in Year 3?
  - (b) Does certification affect the teaching skill level in Year 3?
  - (c) Which induction elements are the most beneficial for teaching practice in Year 3?

The last question should not be confused with the question whether induction arrangements accelerate the growth of teaching skills. Maulana, Helms-Lorenz, and Van de Grift (2014b) have confirmed this by means of a multilevel growth curve analysis in a study with a longitudinal experimental design. Growth was modeled for six teaching skill domains. Beginning teachers who had been supported during the first 3 career years revealed steeper teaching skills growth slopes, compared to their colleagues who were supported to a lesser extent. This current study focuses on disentangling the most beneficial ingredients of induction arrangements on attrition and teaching practice.

Study sample

Since the start of this century, teacher education in The Netherlands has shifted, in line with other countries (e.g., Slovenia; Catelli, Carlino, Jackson, & Petraglia, 2011), in the direction of basing teacher education in the schools. In 2001, the Dutch Education Council advised to grant schools more influence within the educational infrastructure (Onderwijsraad, 2001). First, suggestions towards a more collaborative perspective on educating pre-service and in-service teachers were made (Onderwijsraad, 2001). This implied more collaboration between schools and universities and/or teacher training institutions. Currently, roughly 10% are official professional development schools in secondary education. The number of schools that adhere to this way of working may be much higher, but not officially known. The school-based education entails about 50% of the time spent in the school. The student teachers work on their assignments, attend lectures and workshops, conduct research, and teach. The teaching entails lessons with full responsibility supported by a school-based coach/mentor. The difference with a beginning certified teacher is not visible for pupils and their parents.

We randomly assigned 71 secondary schools with 338 beginning teachers to an experimental or a control group. The schools were scattered equidistantly over all the provinces of The Netherlands, including both urban and rural schools in the sample. The nonresponse rate was equal in both conditions. Pupils of 162 beginning teachers (48%) responded longitudinally.

Table 1 makes clear that, in the 1st year of the experiment, no significant differences between the experimental group and the control group were found concerning gender and teaching subject of the beginning teachers. There are, however, significant differences between the experimental group and the control group concerning the amount of certified teachers and the teaching skills beginning teachers had at the start of their career. The control group had more certified teachers and the beginning teachers had higher skill levels compared to the beginning teachers in the experimental group.

Treatment

Many schools routinely provide beginning teachers extra support by, for example, limiting their class sizes, introducing them to school policy, providing them with support in their professional development, and offering them classroom coaching. Therefore, the teachers in the control group received some induction into the profession, though for a maximum of 1 year. In contrast, the experimental group followed a 3-year induction program under controlled conditions explicitly arranged by the schools themselves, involving workload reduction, enculturation in the school and its policy, professional development planning, classroom observations, and mentoring. Specially trained university supervisors guided

Table 1. Characteristics of the teachers in the 1st year.

	Overall	Experimental group	Control group	Sign.
% female teachers	54.00	54.00	54.00	ns
% teaching a humanities subject	53.63	55.47	51.76	ns
% teaching a science subject	31.45	29.69	33.33	ns
% teaching a social science subject	14.92	14.84	15.00	ns
% certified teachers	65.88	61.11	71.34	.05
Average score (Warm's 0) teaching skills	1.59	1.40	1.78	.03

and supported the induction process, which involved the development of programs of systematic attention for beginning teachers following guidelines derived from prior literature (see Appendices 1 and 2, which were used by the university supervisors to encourage schools to develop own induction arrangements). Schools were monitored in their progress of developing 3-year induction arrangements during these visits. The treatment group differed from the control group in the following substantial ways: (a) The program encompassed 3 years instead of 1. (b) The treatment school developed activities in all the following domains: school enculturation, support in the classroom, support outside the classroom, and workload reduction. Control schools usually chose activities based on availability and convenience. (c) Experimental schools demanded from beginners to attend scheduled activities to a greater extent than beginning teachers in control group schools. Experimental schools were visited 6 to 8 times during a school year. The visits were meetings with a group of school-based educators, school leaders, lesson planners, beginning teachers, and a human resource manager of the school. This group was supported by an experienced university-based teacher in the development of a 3-year induction plan. The visits had a fixed agenda (see manual in Dutch: <http://www.rug.nl/education/lerarenopleiding/onderzoek/inductie/140129handreiking.pdf>).

Implementation measures

Beginning teacher's perception of measures offered by their schools to reduce their workloads was addressed with 20 dichotomous yes/no questions. The perception of measures undertaken by the school to encourage enculturation in the school policy and school rules was addressed with 6 dichotomous yes/no questions. Their perception of the extent to which their schools offer a good infrastructure for professional development was measured with 10 dichotomous items. Finally, we measured the extent to which the beginning teacher was offered classroom observations and coaching by using 9 yes/no items. Examples of the items of the treatment monitor are provided in [Appendix 3](#).

Implementation of the treatment

Differences in the implementation of the induction treatment are shown in *z* scores in [Table 2](#). The very small difference ($ES = 0.15$) between the experimental group and the control group for "providing a good infrastructure for personal development" was not significant. Small differences between the experimental group and control group were found with respect to the implementation of "workload reduction" ($ES = 0.26$), and "enculturation in school policy and school rules" ($ES = 0.25$) was only significant at the 0.10 level. Small and significant ($p = 0.05$; $ES = 0.32$) differences between the

Table 2. Differences in the implementation of the treatment (in *z* scores).

	Experimental condition	Control condition	Sign.	Effect size
Workload reduction	.12	-.13	.07	.26
Enculturation in school policy and school rules	.12	-.13	.08	.25
Personal development plan	.07	-.08	ns	.15
Classroom observation and coaching	.16	-.16	.05	.32

experimental group and the control group were found for “classroom observation and coaching”. Therefore, three of the four elements of induction treatment were slightly better implemented in the experimental group.

Outcome measure

We measured beginning teachers’ skills using a 24-item Rasch scale (Warm’s θ score) that was completed by their students (Maulana, Helms-Lorenz, & Van de Grift, 2014a). We opted to gather information about teaching skills by means of student perceptions for several reasons. First, student perceptions are based on their (classroom) experiences over time, not merely from a snapshot or limited number of observations. Therefore, student perceptions may actually be more important than outsiders’ observations since student perceptions steer individual learning behavior, based on own judgments and insights. Student perceptions are strongly related to their academic engagement (Den Brok, Bergen, Stahl, & Brekelmans, 2004). Research shows that student perceptions are mostly more predictive of student outcomes compared to observations (De Jong & Westerhof, 2001; Seidel & Shavelson, 2007) and teachers’ subjective perceptions of their own teaching behavior (Maulana, Opdenakker, Den Brok, & Bosker, 2011; Scantlebury, Boone, Kahle, & Fraser, 2001). Practically, a questionnaire is mostly preferred because it is considered as the most cost-effective research tool compared to observations (Fraser, 1991).

See [Appendix 4](#) for a list of items and the psychometric details of the instrument. Attrition (school leaving and school switching) was measured by means of exit interviews by telephone determining whether teachers who left their school also left the profession or whether they switched to another school. These interviews also tapped the reasons for leaving the school and/or the profession.

Results

The amount of teachers that leave the school where they started their career within 3 years is 29.9%. This is in agreement with the research literature, where we can find that within 5 years 25% to 40% of the beginning teachers leave their first job (Smith & Ingersoll, 2004; CentERdata, 2013). Our data reveal that 14% switch to another school and only 16% really leave teaching (and could return in later years). So, almost half of the first-job leavers is certainly not lost for the teaching job.

[Table 3](#) reveals that about one third of the beginning teachers are not certified to teach. How does being certificated relate to school switching and job leaving? [Table 3](#) presents an overview.

Being certified is an important predictor for both switching and job leaving. Only about 40% of the teachers who are not certified for the teaching job stay in the school where they started their career. Almost 40% leave the teaching job within 3 years, and about one fifth of the uncertified teachers switch to another school. The amount of switchers and leavers is also relatively high under the student teachers (not yet certified teachers). About a quarter of this group leaves the profession. This amount corresponds to the amount of student teachers that drop out of teacher education. Almost 15% of the student teachers switch to another school. These student teachers leave the school of their traineeship and start working in the school of their first job. A high percentage of student teachers start their career as a teacher in the school of their internship (60%).

Of more concern is the amount of certified beginning teachers that leave the teaching job. About 22% of the certified beginning teachers leave the school where they started

Table 3. Being certified and staying, switching, and leaving during 3 years.

	<i>N</i>	%	Stays	Switches	Leaves
Not certified	33	9.8%	39.4%	21.2%	39.4%
Not yet certified (student teacher)	82	24.3%	59.8%	14.6%	25.6%
Certified	222	65.9%	78.4%	12.6%	9.0%
Total	337	100.0%	70.1%	13.9%	16.0%
<i>Certified for:</i>					
Upper secondary education	95	42.8%	78.9%	14.7%	6.3%
Lower secondary education	113	50.9%	77.9%	12.4%	9.7%
Primary education	14	6.3%	78.6%	–	21.4%

their career. About 13% of the certified beginning teachers switch to another school, and 9% really stop teaching. When we take a closer look at the type of certification, we might conclude that most of the certified job leavers are those who got their teacher training in non-university higher education and who are licensed for teaching in lower secondary education. (A small number of certified teachers trained for primary education work in secondary education in The Netherlands). The amount of first-job leavers amongst the university-trained beginning teachers who are licensed for teaching in upper secondary education is only 6%.

Factors explaining retention

The gross percentage of both school switchers and leavers differs about 1% in favor of the control group. These very small differences between the experimental group and the control group, however, are not significant. We know that the amount of certified teachers and the teaching skills of the beginning teachers in the experimental group differs significantly from the control group; therefore, we corrected these percentages for these variables. Table 4 reveals the results. With analysis of covariance (ANCOVA), we corrected the percentage of leavers for the lower percentage of uncertified beginning teachers and the higher level of teaching skills at the start in the control group. It revealed that 13.75% of the beginning teachers in the control group and 11.63% of the beginning teachers in the experimental group had left the profession. Both covariates, “being certified” and “teaching skills in the 1st year”, were significant at the .001 level. This model with corrections for both the amount of teachers being certified and the level of teaching skills shows a significant ($p < 0.001$) difference of about 2.1% in favor of the

Table 4. Percentages of job leavers and school switchers.

	overall	Experimental group	Control group	Sign
% of teachers who leave the profession within 3 years	16.02	16.67	15.29	.731
% of teachers who switch to another school within 3 years	13.95	13.33	14.65	.729
% of teachers who leave the profession, adjusted for differences in certification and teaching skills	12.67	11.63	13.75	.000
% of teachers who switch to another school, adjusted for differences in teaching skills	11.76	9.78	13.84	.058

experimental group. We also corrected the percentage of switchers with ANCOVA for the lower percentage of uncertified beginning teachers and the higher level of teaching skills at the beginning of the observation in the control group. Only the correction for “teaching skills in the 1st year” was significant ($p < 0.05$). The correction for “being certified” turned out to be not significant. It revealed that after correction 13.84% of the beginning teachers in the control group and 9.78% of the beginning teachers in the experimental group had left the school. This model with a corrected difference for “teaching skills in the 1st year” of about 4.1% in favor of the experimental group is almost significant at the .05 level.

To discern which components of the induction program actually lead to school retention, we performed multilevel logistic regression analyses to determine which characteristics of beginning teachers and which elements of the induction program explain retention in the school. This analytic technique is appropriate when an outcome variable for a regression model has two categories (0 = leaving the school, 1 = staying in the school). Our purpose is to determine the probability of the occurrence of staying/leaving the school under a particular set of teacher and school characteristics. Two-level models were specified, with beginning teacher at Level 1 and school at Level 2. The Level 1 model is specified to compare beginning teachers who left/stayed from the same schools (Equation [1]). Here, RET_{ij} is the response for a teacher i in school j .

$$\text{Logit}(RET_{ij}) = \beta_{0j} + \beta_{1j}COND_{ij} + \beta_{2j}CERTD_{ij} + \beta_{3j}TEACH1_{ij} \quad (1)$$

The dependent variable retention (RET) distinguishes between those who left (0) and stayed (1) in the profession after 3 years of practice. Within each school, the probability of staying in the school for a teacher is modeled as a function of teacher condition (COND, 0 = control, 1 = treatment), certification (CERTD, 0 = uncertified, 1 = certified), and teaching skills at the start (TEACH1). The intercept (β_{0j}) corresponds to the log odds of retention that an average teacher had while in the school j .

The Level 2 model takes into account the differences between schools and estimates these differences in terms of school characteristics. Equation (2) shows that the intercepts from Level 1 (β_{0j}) were modeled as a function of workload reduction in 1st year (WORKL), enculturation in school policy and school rules in 1st year (ENCULT), professional development plan in 1st year (PROF), and classroom observation and coaching (CLASOB) with a random effect (U_{0j}).

$$\begin{aligned} \beta_{0j} &= \gamma_{00} + \gamma_{01}WORKL_j + \gamma_{02}ENCULT_j + \gamma_{03}PROF_j + \gamma_{04}CLASOB_j + U_{0j} \\ \beta_{1j} &= \gamma_{10}, \beta_{2j} = \gamma_{20}, \beta_{3j} = \gamma_{30}, \beta_{4j} = \gamma_{40} \end{aligned} \quad (2)$$

This modeling means that within-school intercepts of each school vary systematically with workload reduction in 1st year, enculturation in school policy and school rules in 1st year, professional development plan in 1st year, and classroom observation and coaching. To make the model simple, the other coefficients of Level 1 ($\beta_{1j}, \beta_{2j}, \beta_{3j}, \beta_{4j}$) were modeled as a fixed slope without random effect. Furthermore, the full model is represented by Equation (3). This model is described by substituting Equation (2) into Equation (1).

$$\begin{aligned} \text{Logit}(RET_{ij}) &= \gamma_{00} + \gamma_{10}COND_{ij} + \gamma_{20}CERTD_{ij} + \gamma_{30}TEACH1_{ij} + \gamma_{01}WORKL_j \\ &\quad + \gamma_{02}ENCULT_j + \gamma_{03}PROF_j + \gamma_{04}CLASOB_j + U_{0j} \end{aligned} \quad (3)$$

Table 5. Multilevel logistic regression analysis explaining school retention during first 3 years.

	Model 0 (Empty model)		Model 1 (Teacher characteristics model)		Model 2 (Full model: Teacher and school characteristics)	
	Coefficient	SE	Coefficient	SE	Coefficient	SE
Fixed effect						
γ_{00} = Intercept: Staying at the same school during first 3 years	0.857***	0.131	0.567	0.363	1.609**	0.569
<i>Level 1 (Beginning teacher)</i>						
γ_{10} = Condition (1 = treatment)			0.386	0.396	-0.032	0.530
γ_{20} = Certification (1 = certified)			0.936**	0.369	0.351	0.526
γ_{30} = Teaching skills at the start			0.931***	0.194	1.025***	0.279
<i>Level 2 (School)</i>						
γ_{01} = Workload reduction in 1st year					0.374	0.292
γ_{02} = Enculturation in school policy and school rules in 1st year					0.251	0.272
γ_{03} = Professional development plan in 1st year					-0.148	0.331
γ_{04} = Classroom observation and coaching in 1st year					0.165	0.299
Random effect						
School-level variance component	0.160	0.183	0.239	0.332	0.151	0.490
Intra-class correlation ¹	0.05		0.07			0.04

Note: *** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$. ¹ICC or the percentage of total variance in outcomes associated with the school level was approximated as: school-level variance/(school-level variance + $\pi^2/3$) (Snijders & Bosker, 2012).

The first part of the equation ($\gamma_{00} + \gamma_{10}\text{COND}_{ij} + \gamma_{20}\text{CERTD}_{ij} + \gamma_{30}\text{TEACH1}_{ij}$) is described as the fixed part of the model and does not include random effect. γ_{00} is the average intercept, and $\gamma_{10}, \gamma_{20}, \gamma_{30}, \gamma_{01}, \gamma_{02}, \gamma_{03}, \gamma_{04}$ are the average regression coefficients of the predictors. Results of the estimates are displayed in Table 5.

Results show that about 5% of the total variation in retention within 3 years could be attributed to differences between schools (intra-class correlation, see Model 0). The fixed effects of all Level 1 predictors are statistically significant, except for condition (see Model 2). Certification and teaching skills at the start are significant predictors of retention. Regarding certification, the coefficient is 0.936. the estimated odds is $e^{0.936} = 2.55$. This means that the probability of a teacher with certification to stay in the school is about 2.55 times the probability of a teacher without certification. For teaching skills at the start, it is estimated that the probability of a teacher with a higher level of teaching skills at the start to stay in the school is about 2.53 times that of a teacher with a lower level of teaching skills at the start. Overall, the results suggest that teachers who are certified and have higher levels of teaching skills at the start have significantly higher probability to stay in the school compared to their peers who are uncertified and have lower levels of teaching skills at the start. The school-level predictors did not reach statistical significance (see Model 3). This means that none of the separate elements of

treatment (induction) is able to predict retention. Even after adding Level 2 predictors, the main effect of teaching skills at the start remains strongly significant.

Factors explaining teaching skills after Year 3

On average, in both conditions beginning teachers who stay in the profession show an increase of 60% of the standard deviation in teaching skill level. In the control group, this growth in teaching skills is 46% of the standard deviation. In the experimental group, this growth after 2 years is 1.6 times more (75%) (see Table 6).

We also used a multilevel regression analysis to determine which elements in the induction program explained the teaching level reached in Year 3. The statistical model of this multilevel analysis is the hierarchical linear model, which can be described as an extension of multiple linear regression to a model that includes nested random coefficients (Snijders & Bosker, 2012). First, we estimated an empty model (Model 0) to estimate the proportion of variance in teaching skills after 3 years for school and teacher levels. The equation form for this empty model is expressed as follows:

$$\text{TEACH3}_{ij} = \beta_{0ij} \text{Constant}$$

$$\text{where } \beta_{0ij} = \beta_0 + u_{0j} + e_{0ij}$$

In this equation, the constant takes the value of 1. Both u_{0j} and e_{0ij} are random quantities forming the random part of the model. The subscript ij means it varies from teacher to teacher within a school. The subscript j means it varies across schools but has the same value for all the teachers within a school. Next, we added Level 1 explanatory variables to Model 0 to estimate effects of teacher characteristics (Model 1). The equation is described as follows:

$$\text{TEACH3}_{ij} = \beta_{0ij} \text{Constant} + \beta_1 \text{COND}_j + \beta_2 \text{CERTD}_{ij} + \beta_3 \text{TEACH1}_{ij}$$

Furthermore, we added Level 2 variables to Model 1 to estimate the effects of school characteristics (Model 2). The equation is described as follows:

$$\begin{aligned} \text{TEACH3}_{ij} = & \beta_{0ij} \text{Constant} + \beta_1 \text{COND}_j + \beta_2 \text{CERTD}_{ij} + \beta_3 \text{TEACH1}_{ij} + \beta_4 \text{WORKL}_{ij} \\ & + \beta_5 \text{ENCULT}_{ij} + \beta_6 \text{PROF}_{ij} + \beta_7 \text{CLASOB}_{ij} \end{aligned}$$

Results in Table 7 show that about 12% of the variance in teaching skills after 3 years could be attributed to the school level, while the remaining 88% of the variance could be attributed to the teacher level (see Model 0). This means that there is a moderate variation

Table 6. Average scores of stayers per condition.

	Grand mean	SD	Exp grp	Ctrl grp	Sign	Effect size
Warm's θ , teaching skills in 1st year	1.59	1.24	1.40	1.78	.03	.31
Warm's θ , teaching skills in 3rd year	2.34	.88	2.33	2.35	ns	.02
Effect size after 2 years	.60		.75	.46		

Table 7. Multilevel regression analysis of teaching level in the 3rd year.

	Model 0 (Empty model)		Model 1 (Teacher characteristics model)		Model 2 (Teacher and school characteristics)	
	Coefficient	SE	Coefficient	SE	Coefficient	SE
Fixed effect						
Intercept: Teaching level in 3rd year	2.350***	0.078	1.973***	0.181	1.897***	0.213
<i>Level 1 (Beginning teacher)</i>						
Condition (1 = treatment)			0.057	0.179	0.087	0.202
Certification (1 = certified)			0.292	0.174	0.318	0.202
Teaching skills at the start			0.373***	0.090	0.457***	0.097
<i>Level 2 (School)</i>						
Workload reduction in 1st year					-0.210***	0.087
Enculturation in school policy and school rules in 1st year					0.097	0.096
Professional development plan in 1st year					-0.044	0.102
Classroom observation and coaching in 1st year					0.264**	0.091
Random effect						
School-level variance component	0.092	0.070	0.153	0.083	0.201	0.098
Residual	0.670	0.092	0.538	0.086	0.457	0.086
Deviance	408.271		302.948		234.942	

Note: *** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$.

in teaching skills across schools, and a large variation in teaching skills between beginning teachers.

Certification and teaching skills at the start explain differences in teaching level in the 3rd year (see Model 1). Furthermore, workload reduction and classroom observation and coaching in the 1st year predict the teaching level in the 3rd year (see Model 2). Teaching skills at the start has a significant unique effect on teaching skills after 3 years and explains about 8% of the variance. Teaching skills at the start, workload reduction in 1st year, and classroom observation and coaching in 1st year together explain about 14% of the variance.

Because the instrument used for these measurements meets the requirements of the Rasch model, we can order both items and beginning teachers on a single dimension, meaning that we can also place the teachers who left the profession or switched to another school on this same dimension. It is notable that all beginning teachers who left the teaching profession or switched to another school lack the following skills, according to their pupils:

- explaining the purpose of the lesson to me;
- ensuring that I do my best;
- explaining everything clearly to me;
- paying attention to me;
- applying clear rules;
- ensuring that I pay attention.

Conclusion and discussion

This study has focused on the longitudinal effects of an induction arrangement on retention and the improvement in teaching skills after 3 years in the profession. Our analyses yielded that the extent of attrition in the Dutch secondary schools is smaller than expected. Only 9% of the certified teachers actually left the profession. Given this, it is not surprising that the effects of induction on retention are small too. After having adjusted for the significantly higher percentage of certified beginning teachers and the higher teaching skills at the start in the control group, the experimental group exhibited a 2% higher retention rate compared to the control group. Additionally, we found (after adjustments) that the experimental group revealed 4% less school switching. Being certified as a teacher and having higher teaching skills at the beginning of the career engenders school retention rates. The probability of a certified teacher staying in the same school for 3 years is about 2.6 times that of the uncertified teacher. The probability of a teacher with higher teaching skills at the start staying in the same school for 3 years is about 2.5 times that of the teacher with lower teaching skills at the start.

Our study revealed that the teacher shortage problem cannot be substantially solved by reducing attrition rates of beginning teachers, as the retention rates have been shown to be low. The solution might rather be sought in attracting more (highly qualified) candidates to become teachers.

Beginning teachers in the experimental condition show greater improvements in teaching skills compared to the teachers in the control group. The findings concerning the predictive value of induction arrangement elements on the skill level in Year 3 revealed significant school-level effects. Workload reduction influences the outcome negatively, and coaching and observing has a positive impact on skill level in Year 3.

Our study revealed that the problem of the discrepancy in teaching skill levels between the beginning teachers and the retiring teachers can effectively be diminished by induction programs.

Our study also revealed that approximately 29% of the beginning teachers left their first school within the first 3 years. Approximately 16% actually left the profession. This is much less than expected. Governmental career attrition numbers seem to be confounded with teachers switching between schools.

The average teaching skill level of the school switchers is remarkably lower than that of the stayers, but not as low as that of the career enders. This is in line with Henry, Bastian, and Fortner (2011), who found that stayers show higher levels of teaching skills compared to leavers. This finding calls for closer scrutiny of early career school switching to reveal whether these teachers are actually staying in the long run or whether leaving is being postponed.

Both certification status and higher teaching skill levels at the outset of the career were shown to be important factors explaining school retention. This finding implies that our induction arrangements at the school level cannot compensate for teacher education. Given the low attrition rates found in this study, the problem should not be inflated. States should ensure that unqualified teachers complete teacher training first, before they are given the responsibilities of a certified teacher. Student teachers who still have trouble with classroom management and basic instruction should not be certified. This recommendation is in line with evidence from the United States and The Netherlands that confirms that licensure status matters (Borman & Dowling, 2008). Teacher education standards might need to be raised in order to prevent

attrition. This could save a great deal of the taxpayer's money. Interventions aiming to increase the retention of certified teachers should be targeted at the teacher level rather than the school level.

Our results revealed that less effective teachers are more likely to leave the profession. Is this a problem or is a certain level of attrition beneficial for the teaching force? Under normal circumstances, low attrition rates (say 5%) should not be problematic. (Reducing attrition rates to 0% could theoretically be possible if teachers are to be certified only when they reach a certain level of teaching skills.) However, from a policy perspective, in a period of teacher shortages (irrespective of the cause), teachers leaving schools might be worse than a less skillful teacher staying. The option of no teacher (or a revolving door of teachers coming and going within the same school year) versus a less skillful teacher being taught to teach, and supported in the school to learn, might be better than no teacher at all. Therefore, teacher education should be closely integrated in induction arrangements. The curriculum and support should be dovetailed to ensure a smooth transition during the first years on the job and should be highly focused on skill development. From the pupils' and parents' point of view, student and beginning teachers are on average less effective for learners. It is therefore recommended that schools allowing for student internships and jobs for (less able) beginning teachers should compensate pupils for less effective teaching by linking these pupils to highly skilled teachers that monitor classrooms intensely, allowing them to intervene in lessons and providing pupils with additional classes and supporting material on electronic learning environments. This procedure is also evidenced in other professions: Medical and law students work under the supervision of highly qualified doctors and lawyers who remain responsible for the diagnosis and treatment of patients/clients. This responsibility is not passed on fully to the less skillful early career professional.

In the educational setting of The Netherlands, schools differ in the quality of the support they offer their beginning teachers. Some control group schools approached the ideal induction arrangement, others had poor induction arrangements. Our analyses show that all the elements of the induction arrangements are slightly stronger in the experimental condition (which is a complement to the control group schools in The Netherlands, which manage to support their beginning teachers without outside interventions). All the elements can be strengthened in the experimental condition. Future experimental research should focus on the improvement of the quality and execution of the intervention.

The negative interaction finding between workload reduction and being certified is not what we expected to find. Reducing the workload leads to lower 3rd-year teaching skills. We therefore recommend future research projects to experiment with *less* workload reduction in induction arrangements for beginning teachers. Determining adequate workloads that are beneficial for beginning teachers' learning to become better teachers, seems to be important. As skillfulness increases, the workload should increase. This might strengthen future induction arrangements.

The strongest effect was shown for teachers being observed and coached: Teachers benefit from coaching and being observed. Coaching and observing is the most powerful induction ingredient measured in this experiment. This is in line with international findings of the effects of mentoring (Ingersoll & Strong, 2011).

An important issue is the cost effectiveness of induction arrangements. The induction arrangement we implemented was an investment of six to eight school visits over a period of 1 school year. This is relatively inexpensive compared with more comprehensive interventions focusing on coaching mentors and leadership teams on the job for 2 to 3 years, as in, for example, Houtveen and Van de Grift (2007a, 2007b, 2012), Houtveen, Van de Grift, and Brokamp (2014) and Houtveen, Van de Grift, and

Creemers (2004). This intensive school and teacher involvement has led to stronger positive effects (approximately one full standard deviation) in teaching skill development. Thus, the question governments and policy makers must address is this: Given a limited budget, should more beginning teachers be exposed to induction arrangements through less expensive interventions or fewer teachers through more expensive interventions?

This study contributes to the body of knowledge involving ways to address teacher shortages and enhance professional skills of beginning teachers. The weakness of the intervention and the quality of the coaching is an important concern. In future projects, the observation and mentoring of beginning teachers in their classrooms should be more prominent. However, in practice, the daily time constraints of teachers and coaches/mentors hinder this aspect of induction arrangements. It is the first task eliminated when stakeholders have tight time schedules, which reduces the desired effects.

Acknowledgements

Our special thanks go to Anna Verkade, Jaap Buitink, Chrisbert van Mourik, Geke Schuurman, Carla Griep, Wiepkje 't Hart, and Bert Slof for their great commitment and dedication to the national induction program.

Disclosure statement

No potential conflict of interest was reported by the author(s).

Funding

This work was supported by the Dutch Ministry of Education (Onderwijs Bewijs; Action Program Education Evidence) [grant number ODB08110].

Notes on contributors

Michelle Helms-Lorenz is an associate professor at the Department of Teacher Education, University of Groningen, The Netherlands. Her research interest includes the teaching skills and wellbeing of beginning and pre-service teachers and effective interventions to promote their professional growth and retention.

Wim van de Grift is a full professor and director of the Department of Teacher Education, University of Groningen, The Netherlands. His research interest involves educational effectiveness, professional development of teachers, quantitative methodology, as well as subject-related teaching skills and performances.

Ridwan Maulana is an assistant professor at the Department of Teacher Education, University of Groningen, The Netherlands. He received his doctorate in educational sciences from the same university. His major research interests involve teaching and teacher education, learning and instruction, as well as statistics and methods associated with the measurements of teaching in the context of teacher education.

References

- Aaronson, D., Barrow, L., & Sander, W. (2007). Teachers and student achievement in the Chicago public high schools. *Journal of Labor Economics*, 25, 95–135.
- Algozzine, B., Gretes, J., Queen, A. J., & Cowan-Hathcock, M. (2007). Beginning teachers' perceptions of their induction program experiences. *The Clearing House*, 80, 137–143.

- Alliance for Excellent Education. (2004). *Tapping the potential: Retaining and developing high-quality new teachers* (Report). Retrieved from <http://www.all4ed.org/publications/TappingThePotential/TappingThePotential.pdf>
- Andrews, S. P., Gilbert, L. S., & Martin, E. P. (2007). The first years of teaching: Disparities in perceptions of support. *Action in Teacher Education*, 28(4), 4–13.
- Borman, G. D., & Dowling, N. M. (2008). Teacher attrition and retention: A meta-analytic and narrative review of the research. *Review of Educational Research*, 78, 367–409.
- Bosker, R. J., & Witziers, B. (1996, April). *The magnitude of school effects, or does it really matter which school a student attends?* Paper presented at the Annual Meeting of the American Educational Research Association, New York, NY.
- Brandsma, H. P., & Knuver, A. W. M. (1989). Pupils' sense of well-being and classroom educational factors. In B. P. M. Creemers, T. Peters, & D. Reynolds (Eds.), *School effectiveness and school improvement: Proceedings of the second international congress* (pp. 131–140). Lisse: Swets & Zeitlinger.
- Brock, B. L., & Grady, M. L. (1997). Principals: The guiding light for new teachers. *Momentum*, 28(2), 52–55.
- Catelli, L., Carlino, J. J., Jackson, V., & Petraglia, G. (2011). A PDS partnership goes international: Phase I of an American-Slovenian collaborative research project. *Scholar-Practitioner Quarterly*, 5, 394–411.
- CentERdata. (2013). *De toekomstige arbeidsmarkt voor onderwijspersoneel 2013–2025* [The future of the labor market for educational staff]. Tilburg: Tilburg University.
- Cohen, B., & Fuller, E. J. (2006, April). *Effects of mentoring and induction on beginning teacher retention*. Paper presented at the Annual Meeting of the American Educational Research Association, San Francisco, CA.
- Créton, H., & Wubbels, T. (1984). *Ordeproblemen bij beginnende leraren* [Discipline problems of beginning teachers]. Utrecht: WCC.
- Danielson, C. (2002). *Enhancing student achievement: A framework for school improvement*. Alexandria, VA: Association for Supervision and Curriculum Development.
- Darling-Hammond, L. (2003). Access to quality teaching: An analysis of inequality in California's public schools. *Santa Clara Law Review*, 43, 101–239.
- De Jong, R., & Westerhof, K. (2001). The quality of student ratings of teacher behaviour. *Learning Environments Research*, 4, 51–85.
- De Jonge, J. F. M., & De Muijnck, J. A. (2002). *Waarom leraren de sector verlaten. Onderzoek naar de uitstroom in het primair en secundair onderwijs* [Why teachers leave their jobs. Study of teacher attrition in primary and secondary education]. Zoetermeer: EIM.
- Den Brok, P., Bergen, T. Stahl, R. J., & Brekelmans, M. (2004). Students' perceptions of teacher control behaviours. *Learning and Instruction*, 14, 425–443.
- Duke, L., Karson, A., & Wheeler, J. (2006). Do mentoring and induction programs have greater benefits for teachers who lack pre-service training? *Journal of Public and International Affairs*, 17. Retrieved from <http://www.princeton.edu/jpia/past-issues-1/2006/4.pdf>
- Feiman-Nemser, S., Carver, C., Schwillie, S., & Yusko, B. (1999). *Conceptual review of literature on new teacher induction*. Washington, DC: National Partnership for Excellence and Accountability in Education.
- Fideler, E. F., & Haselkorn, D. (1999). *Learning the ropes: Urban teacher induction programs and practices in the United States*. Belmont, MA: Recruiting New Teachers.
- Fraser, B. (1991). Two decades of classroom environment research. In B. J. Fraser & H. J. Walberg (Eds.), *Educational environments: Evaluations, antecedents and consequences* (pp. 3–27). Elmsford, NY: Pergamon.
- Fuller, B. (2003). Education policy under cultural pluralism. *Educational Researcher*, 32(9), 15–24.
- Glazerman, S., Goldhaber, D., Loeb, S., Raudenbush, S., Staiger, D. O., & Whitehurst, G. J. (2010). *Evaluating teachers: The important role of value-added*. Washington, DC: Brown Center on Education Policy at Brookings. Retrieved from http://www.brookings.edu/reports/2010/1117_evaluating_teachers.aspx
- Hanushek, E. A. (2011). The economic value of higher teacher quality. *Economics of Education Review*, 30, 466–479.
- Hanushek, E. A., & Rivkin, S. G. (2010). The quality and distribution of teachers under the No Child Left Behind Act. *Journal of Economic Perspectives*, 24(3), 133–150.

- Helms-Lorenz, M., Slof, B., & Van de Grift, W. J. C. M. (2013). First year effects of induction arrangements on beginning teachers' psychological processes. *European Journal of Psychology of Education*, 28, 1265–1287. doi:10.1007/s10212-012-0165-y
- Henry, G. T., Bastian, K. C., & Fortner, C. K. (2011). Stayers and leavers: Early-career teacher effectiveness and attrition. *Educational Researcher*, 40, 271–280.
- Houtveen, A. A. M., & Van de Grift, W. J. C. M. (2007a). Effects of metacognitive strategy instruction and instruction time on reading comprehension. *School Effectiveness and School Improvement*, 18, 173–190.
- Houtveen, A. A. M., & Van de Grift, W. J. C. M. (2007b). Reading instruction for struggling learners. *Journal of Education for Students Placed At Risk*, 12, 405–424.
- Houtveen, A. A. M., & Van de Grift, W. J. C. M. (2012). Improving reading achievements of struggling learners. *School Effectiveness and School Improvement*, 23, 71–93.
- Houtveen, A. A. M., Van de Grift, W. J. C. M., & Brokamp, S. K. (2014). Fluent reading in special elementary education. *School Effectiveness and School Improvement*, 25, 555–569.
- Houtveen, A. A. M., Van de Grift, W. J. C. M., & Creemers, B. P. M. (2004). Effective school improvement in mathematics. *School Effectiveness and School Improvement*, 15, 337–376.
- Houtveen, A. A. M., Versloot, B., & Groenen, A. (2006). *De begeleiding van startende leraren in het voortgezet onderwijs en in het basisonderwijs* [Coaching teachers in primary and secondary education]. Den Haag: Sectorbestuur Onderwijsarbeidsmarkt (SBO).
- Huling-Austin, L. (1990). Teacher induction programs and internships. In W. R. Houston, M. Haberman, & J. Sikula (Eds.), *Handbook on research on teacher education* (pp. 535–548). New York, NY: Macmillan.
- Ingersoll, R. M., & Smith, T. M. (2003). The wrong solution to the teacher shortage. *Educational Leadership*, 60(8), 30–33.
- Ingersoll, R. M., & Strong, M. (2011). The impact of induction and mentoring programs for beginning teachers: A critical review of the research. *Review of Educational Research*, 81, 201–233.
- Kane, T. J., & Staiger, D. O. (2008). *Estimating teacher impacts on student achievement: An experimental evaluation* (NBER Working Paper No. 14607). Cambridge, MA: National Bureau of Economic Research.
- Kapadia, K., Coca, V., & Easton, J. Q. (2007). *Keeping new teachers: A first look at the influences of induction in the Chicago Public Schools*. Chicago, IL: Consortium on Chicago School Research, University of Chicago.
- Lindqvist, P., Norrdäng, U. K., & Carlson, R. (2014). Teacher attrition the first five years: A multifaceted image. *Teaching and Teacher Education*, 40, 94–103.
- Maulana, R., Helms-Lorenz, M., & Van de Grift, W. (2014a). Development and evaluation of a questionnaire measuring pre-service teachers' teaching behaviour: A Rasch modelling approach. *School Effectiveness and School Improvement*. Advance online publication. doi:10.1080/09243453.2014.939198
- Maulana, R., Helms-Lorenz, M., & Van de Grift, W. (2014b). *Does beginning teachers' teaching quality get better over time? A longitudinal study based on student perceptions during the first three years of professional practice*. Manuscript submitted for publication.
- Maulana, R., Opendakker, M.-C., Den Brok, P., & Bosker, R. (2011). Teacher-student interpersonal relationships in Indonesia: Profiles and importance to student motivation. *Asia Pacific Journal of Education*, 31, 33–49.
- Onderwijsraad. (2001). *Ten dienste van de school* [Serving the school]. Den Haag: Artoos.
- Organisation for Economic Co-operation and Development. (2012). *Education at a glance*. Paris: Author.
- Rivkin, S. G., Hanushek, E. A., & Kain, J. F. (2005). Variable definitions, data, and programs for teachers, students, and academic achievement. *Econometrica Supplementary Material*, 73(2). Retrieved from www.econometricsociety.org/ecta/supmat/4139data.pdf
- Rockoff, J. E. (2004). The impact of individual teachers on student achievement: Evidence from panel data. *American Economic Review*, 94(2), 247–252.
- Roeleveld, J. (2003). *Veranderingen in het kleuteronderwijs. Ontwikkelingen in en effecten van het kleuteronderwijs op de cognitieve en niet-cognitieve ontwikkeling van oudste kleuters tussen 1994 en 2000. Analyses bij het PRIMA cohort onderzoek, 4e meting* [Changes in pre-school education. Developments and effects of pre-school education on cognitive and non-cognitive

- development of the oldest children between 1994 and 2000. Analysis of the PRIMA cohort research, 4th measurement]. Amsterdam: SCO-Kohnstamm Instituut.
- Scantlebury, K., Boone, W., Kahle, J. B., & Fraser, B. J. (2001). Design, validation, and use of an evaluation instrument for monitoring systemic reform. *Journal of Research in Science Teaching*, 38, 646–662.
- Seidel, T., & Shavelson, R. J. (2007). Teaching effectiveness research in the past decade: The role of theory and research design in disentangling meta-analysis results. *Review of Educational Research*, 77, 454–499.
- Smith, T. M., & Ingersoll, R. M. (2004). What are the effects of induction and mentoring on beginning teacher turnover? *American Educational Research Journal*, 41, 681–714.
- Snijders, T. A. B., & Bosker, R. J. (2012). *Multilevel analysis: An introduction to basic and advanced multilevel modeling* (2nd ed.). London: SAGE.
- Stevens, R. J. (2004). Why do educational innovations come and go? What do we know? What can we do? *Teaching and Teacher Education*, 20, 389–396.
- Strong, M., Gargani, J., & Hacifazlioglu, Ö. (2011). Do we know a successful teacher when we see one? Experiments in the identification of effective teachers. *Journal of Teacher Education*, 62, 367–382.
- Van de Grift, W. (2010). *Ontwikkeling van de beroepsvaardigheden van leraren* [Development of teaching skills] (Inauguration speech). University of Groningen, Groningen.
- Van Kregten, A., & Moerkamp, T. (2004). *Startende leraren in het buitenland* [Beginning teachers in foreign countries]. Den Haag: SBO.
- Veenman, S. (1984). Perceived problems of beginning teachers. *Review of Educational Research*, 54, 143–178.
- Vonk, J. H. C. (1982). *Opleiding en praktijk* [Teacher training and practice] (Doctoral dissertation). Amsterdam: VU-Uitgeverij.
- Wijnstra, J., Ouwens, M., & Béguin, A. (2003). *De toegevoegde waarde van de basisschool* [Value added of primary schools]. Arnhem: Citogroep.
- Wong, K. H. (2004, March). Induction programmes that keep new teachers teaching and improving. *NASSP Bulletin*, 88(638), 41–58.

Appendix 1. Guidelines to optimize working conditions; ensuring instructive work and reducing work pressure

Goals	Measure that leads to less stress	Examples of activities
Optimizing organizational preconditions and optimizing the working situation Tailor-made measures: fine-tuning of work pressure, challenges, and capacity	No extra tasks	• No tutorship (build up from 1–3); also made to measure; starting point as basis • No extra tasks • Reduced number of lessons • Discuss perception of work pressure with coach • Learn time management • Organize work efficiently, work goal oriented • Learn to be a chairman • Keep guard over time, also after school
Give no assignments that cannot be accomplished: not too easy and not too difficult assignments.	Attune work to beginning teachers' (BT's) capacity	• Take care of tailor-made assignments: • Provide the opportunity to reflect on workload • Give possibility to change classes • Make and keep tasks suitable • Teach parallel classes preferably with experienced colleague
	Advantageous schedules	• Preferably no scheduled lessons at the end of the day • Schedule weekly hour for support • Secure confidentiality between BT and support provider • Attune schedules of BTs and the subject coach • Communicate well with schedules makers • Reduce excessive commuting between buildings • Provide BTs with own classrooms
Acknowledgement of the fact that development takes time	Develop induction arrangements for the duration of 3 years and see to a gradual increase of workload up to the normal end level	• Provide a quiet and good workplace • Provide continual "fitting" challenges
Instructive workplace	Placement in particular classes and teams.	• Provide accessible resources • Placement in dynamic, helpful teams • Trying to have the supporting teacher and the coach in the same team • Organize weekly (peer) reflection sessions

Appendix 2. Measures to support the development of the beginning teacher

Domains	Developmental goals	Guidelines	Content of activities to accomplish goals (what?)	Activity (how?)
School organization and context	To gain specific background knowledge of students, the curriculum, the school, and the social context.	Provide opportunity for informal, unintentional learning Take school policy into account when developing an induction arrangement Providing a coach of the same school and same subject field (matching teaching conceptions between mentee and mentor increases effectiveness) Provide opportunities for formal learning BT who had an appointment during their internship should be treated in the same way as BT who had their internship elsewhere.	● Getting to know the content of student files (study progress and personal information) and learning how to use this information correctly ● Knowing what the role of teachers is ● Getting to know the social context of the average student ● Knowing the mission, the identity, and the uniqueness of the school ● Getting to know the structure, organization, and culture of all sections/departments within school ● Being aware of pupil transition problems inside the school. ● Being informed about current social discussions concerning education	● Appoint a (senior) teacher to be responsible for BTs, for instance, a school educator or a team leader ● Activities directed to introduce the use of student files ● Having informal conversations with students ● Have BTs participate with school trips, not as organizers ● Supply information about school structure, organization, and culture. ● Provide opportunities to attend different kinds of meetings ● Be transparent about decisions made by the school concerning the organization of learning processes. ● Let BT's visit other teams, locations, levels, departments in and outside of the school ● Make social developments accessible and discussible, for instance, by using journal articles, newspaper articles, subscription to journals, either on paper or on the internet ● See to it that social developments are discussed during meetings

(continued)

Appendix 2. (Continued)

Domains	Developmental goals	Guidelines	Content of activities to accomplish goals (what?)	Activity (how?)
Pedagogical and didactical behavior	Cultivation of consciousness of the fact that you are part of a team and an institution and knowing your responsibilities	Provide the opportunity for the BT to be a full member of the institution (in rights and duties)	• Getting to know the values and norms of the organization and its members • Getting to know the explicit and implicit rules of the organization • Learning to meet effectively	• Coach collegiality • Provide transparency • Quality assurance system • Learning effective time-management skills • Attending meetings and workshops • Learning effective meeting skills • Discuss how to behave as a colleague during meetings and in the teams • Critical reading of learning theories and from scientific publications and literature
	Focus on learning of the students as a starting point of pedagogical and didactical behavior	Stimulate lifelong learning	• Knowledge about theories of learning processes and integration thereof into the subject • Continuous development of the notion of "how learning works" • Noticing (assessing, observing) if and how students learn	• Using think-out-loud-protocols of students and analyzing these • Attending workshops about learning and teaching
	Deepening and extending subject-content knowledge	Lifelong learning Building on a knowledge base that transcends the own subject matter	• Keeping track of latest knowledge of the subject and latest developments	• Consulting scientific literature • Attending courses/extra training/congresses • Consulting different teaching methods

(continued)

Appendix 2. (Continued)

Domains	Developmental goals	Guidelines	Content of activities to accomplish goals (what?)	Activity (how?)
	Applying, extending, and refining beginning behavior repertoire	Provide opportunities for reflection on own behavior Developing a notion of own classroom behavior and how this effects pupils	• Being informed about new developments in didactics • Noticing differences between students (backgrounds, behavior, development) • Learning to treat (groups of) individuals differently in order to enhance overall learning. • Learning which differences call for didactic differentiation • Improve effectivity of own teaching • Intensifying interaction with and between students	• Attending thematic workshops or workshops with experts • Coaching on the job • Study literature and other relevant information • Develop evidence-based teaching • Specific observation and processing of feedback • Watching and discussing video recordings of oneself and others • Preparing lessons together: in pairs and/or in teams • Asking feedback on a plan for a lesson • Workshop about learning to develop strategies for teaching • Observing the behavior of an expert • Giving space for experimentation through mutual observations in lessons
	Knowledge about student counseling and being able to function as a tutor	Developing knowledge of counseling and exercising the skills	• Introduction to student counseling in general and in this school specifically • Develop communication skills • Getting to know the limits of tutoring	• Getting training to be a tutor and growing into tutorship • Training of conversation skills for conversations with students • Being informed about specific issues as incest, domestic violence, etc.

(continued)

Appendix 2. (Continued)

Domains	Developmental goals	Guidelines	Content of activities to accomplish goals (what?)	Activity (how?)
	The development of an effective learning climate in the classroom, for instance, creating a safe pedagogical climate	Negotiating with students about the learning climate Consulting with colleagues, reflection Observation and feedback Translate theory to practice	• Being informed about the rules of the school, protocols, and being able to play with it • Knowing theory about motivation, group behavior, problem behavior, bullying, etc. • Being informed about group dynamics • Setting boundaries/limits • Knowledge of effects of own behavior • Managing individual differences • Being able to name values and norms in the classroom and taking care of the execution of the rules	• Introduction to school rules • Consulting and using literature • Talking with tutors • Attending thematic workshops • Having conversations with students about values and norms. Exchanging thoughts with colleagues about this. Making consequences explicit.
	Being aware of your role			
	Knowledge of the individual differences between students and their diversity	Acknowledgement of the complexity of a heterogeneous group	• Understanding problem behavior like ADHD, PDDNOS, dyslexia, dyscalculia • Knowledge of facilities to support special needs	• Making background information available, journals, etc. • Consulting these sources • Attending student discussions in teams
	Skills to manage these differences			
	Special attention for and knowledge of the problems of students with special needs		• Being informed about behavior protocols like bullying behavior and coping with grief • Knowledge of the role of the teacher with regard to special needs • Team knowledge of roles and tasks that concern special needs children • Learning to read action plans developed to support special needs learning to execute and evaluate these plans	• Coordinator of care gives information about set-up, content and structure of care

(continued)

Appendix 2. (Continued)

Domains	Developmental goals	Guidelines	Content of activities to accomplish goals (what?)	Activity (how?)
Learning of the own education practice, professional development	Strengthening the skills to study and improve the own practice of education	Being able to work together with different colleagues: in schools, with universities and colleges of higher education	• Systematical reflection: analyzing the own education practice • Using results of this to improve education	• Systematic reflecting on lessons; by using theoretical concepts and experiences and by paying attention to own development of concept of teaching
	Develop an own vision and being able to change concepts	Stimulating a developing attitude Learning to see what influence the school policy (context) has Acknowledgement of the relative autonomy of the teacher Providing room for experimenting in this Acknowledgement of the own strengths and further developing these	• Processing theories • Getting the opportunity to learn from experts • Direct observation and learning tools • Integration of information gained from several sources: feedback on observations of lessons, feedback from students and performances of students • Developing own teaching concepts	• Systematic examination of the own concepts • Making use of insights gained by research on "evidence-based effective teaching" • Generating systematic feedback • Working on this in a team • Being able to discuss this with someone else
	Examining the practice of education	Learning to act in an investigating way in and from authentic situations	Developing an investigating method of working	• Performing (action) research • Reading and interpreting research publications
	Increasing the self-regulation of the own professional development	Developing metacognitive skills and knowledge of the own learning process and development as a teacher	• Increasing awareness of the (own) learning process on the job • Being aware of and making use of opportunity to experiment • Recognizing own successes • Being able to regulate own professional development, not being a victim • Knowledge of system theory • Daring to distinguish yourself from others	• Systematic experimentation • Developing a proactive attitude • Learning to take time to develop oneself • Reflection on own development • Gathering knowledge of ways to learn on the job and learning from experiences • Discovering and explicating an own style to learn on the job and learning from experiences • Time management course
Balance	Finding a balance between work and private life	Acknowledgement that the beginning teacher is an employee for the first time		

Appendix 3. Treatment monitor

Examples of measures to reduce workload (20 yes/no items)

The possibility to work part-time
Teach fewer lessons compared to experienced teachers
Not being a pupil counselor in the 1st year on the job
No extra tasks to execute within your team of teachers
Exemption of extracurricular activities

...

Examples of measures to stimulate enculturation in school policy and school rules (6 yes/no items)

Does your school offer an introduction meeting for beginning teachers?
Does your school offer written information about the structure, organization, and school culture for beginning teachers?
Does your school introduce you to other departments, teams in other buildings, different levels of pupils

....

Examples of measures to stimulate professional development (10 yes/no items)

Do you work with a professional development plan?
Do you have progress interviews with your team leader?
Does your school use adequate instruments to support you?
Does your school use good observation instruments?
Does your school use good methods to provide feedback after lesson observations?
Does your school use clear criteria when judging your performance?

....

Examples of coaching and observing (9 yes/no items)

Do you observe at least 3 lessons of coworkers per year?
Do you have a follow-up discussion after your observation of a coworker?
Do you receive feedback after your lesson has been observed?
Do you prepare lessons with coworkers?
Do you evaluate your teaching practice with coworkers?

....

Appendix 4. Items, *p* values, item difficulties, item slopes, raw scores, and person parameters of the teacher scale

	Item difficulty			Item slope		Raw score	Warm's Θ	<i>SE</i>
	<i>p</i>	<i>b</i>	<i>SE</i>	<i>a</i>	<i>SE</i>			
My teacher...						0	-4.13	1.48
treats me with respect.	.86	-1.40	.20	1.82	.31	1	-2.97	.88
prepares his/her lesson well.	.82	-.90	.18	1.64	.27	2	-2.39	.70
answers my questions.	.80	-.68	.18	2.30	.35	3	-1.99	.61
involves me in the lesson.	.79	-.65	.18	1.97	.30	4	-1.67	.55
makes clear what I need to study for a test.	.79	-.65	.18	2.35	.36	5	-1.40	.51
helps me if I do not know or am unable to do something.	.79	-.62	.18	3.37	.55	6	-1.16	.49
ensures that I treat others with respect.	.78	-.56	.17	1.76	.27	7	-.94	.47
helps me if I do not understand or am unable to do something.	.76	-.36	.17	2.55	.38	8	-.74	.45
explains how I need to do things.	.76	-.33	.17	2.63	.40	9	-.55	.44
uses clear examples.	.76	-.30	.16	3.36	.53	10	-.36	.44
explains the purpose of the lesson.	.74	-.20	.17	2.47	.36	11	-.18	.43
ensures that I do my best.	.73	-.09	.16	2.34	.34	12	.01	.43
explains everything clearly to me.	.73	-.09	.16	2.81	.41	13	.18	.43
pays attention to me.	.73	-.09	.16	2.48	.36	14	.36	.44
applies clear rules.	.72	-.02	.16	2.03	.29	15	.55	.44
ensures that I pay attention.	.68	.32	.16	2.16	.30	16	.74	.45
connects to what I know or am capable of.	.67	.35	.16	2.52	.36	17	.94	.47
checks whether I have understood the subject matter.	.65	.54	.15	1.74	.25	18	1.16	.49
ensures that I use my time effectively.	.63	.72	.15	1.99	.27	19	1.40	.51
makes me feel self-confident with difficult tasks.	.62	.78	.15	2.17	.30	20	1.67	.55
stimulates my thinking.	.60	.90	.15	1.85	.26	21	1.99	.61
explains how I should study something.	.60	.92	.15	2.58	.36	22	2.39	.70
motivates me.	.58	1.05	.15	2.92	.42	23	2.97	.88
knows what I have difficulty with.	.54	1.36	.15	2.18	.30	24	4.13	1.48