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Does teachers' pedagogical content knowledge affect their fluency instruction?

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Abstract The relation is studied between teachers' pedagogical content knowledge of reading and the quality of their subsequent classroom behaviour in teaching fluent reading. A confirmatory factor analysis model with two latent variables is tested and shows adequate goodness-of-fit indices. Contrary to our expectations, the results of structural equation modelling reveal a small but significant γ -value of .29, indicating that only 8% of the variance in teachers' classroom behaviour in teaching fluent reading is accounted for by teachers' pedagogical content knowledge of reading. Presumably teacher knowledge is not as stable and conclusive as one might think. More research is needed in determining the factors that work restricting for teachers in putting their knowledge into classroom practice. It is recommended that pre-service and in-service teacher training should not be limited to transfer of knowledge, but should also assist teachers in designing and performing effective fluent reading instruction.

Keywords Pedagogical content knowledge · Reading fluency · Structural equation modeling · Primary education · Teacher training

Introduction

From the assumption that fluent reading would develop more or less automatically, once sufficient word-reading skills were established, the attention for reading fluency has long been neglected in classroom practice as well as in the academic

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study of teaching reading (Allington, 1983; Rasinski, 2003). To date reading fluency is seen as one of the critical components of skilled reading (e.g., Kuhn, Schwaneflugel, & Meisinger, 2010; National Institute of Child Health and Human Development, 2000; Rasinski & Hoffman, 2003; Samuels & Farstrup, 2006). Being a skilled reader at an early age is extremely important for a subsequent school career and in further education. This importance is underlined when we look at further analyses of the results from the Programme for International Student Assessment (PISA), which show that 17% of the 15-year-old students in the United States score below Level 2, which means that they are functionally illiterate (Kelly, Nord, Jenkins, Chan, & Kastberg, 2013). The results in a lot of European countries are roughly on a same level. Analyses of PISA-results in the Netherlands for instance, show that the percentage of functionally illiterate students in education in the last decade fluctuates around 14% (Kordes, Bolsinova, Limpens, & Stolwijk, 2013). These students can read and write simple sentences with a limited vocabulary, but are not able to read or write well enough to deal with the everyday requirements of their lives. Being aware of these statistics makes it obvious that helping students to become fluent readers is one of the most important tasks for staff members in primary education. Although, at first sight, this might look relatively easy, every experienced teacher will confirm that it is far from being a simple job. Several scholars have acknowledged that reading teachers cannot simply rely on their intuition or on common sense but, instead of that, need to dispose of a vast body of specialized knowledge (e.g., Callahan, Benson-Griffo, & Pearson, 2009; Lyon & Weiser, 2009; Moats, 2009). Some research is done on the development of teachers' knowledge of linguistic structures and basic components of the beginning reading process (e.g., Bos, Mather, Dickson, Podhajski, & Chard, 2001; Cunningham, Perry, Stanovich, & Stanovich, 2004; Moats, 1994; Moats & Foorman, 2003; Spear-Swerling & Brucker, 2003; Spear-Swerling, Brucker, & Alfano, 2005) and on the influence of this knowledge on teachers' instructional behavior (e.g., McCutchen et al., 2002a, b; McCutchen, Green, Abbott, & Sanders, 2009; Piasta, McDonalds-Conner, Fishman, & Morrison, 2009). Far less is known of teachers' knowledge of fluent reading. Furthermore, possessing a high level of knowledge of fluent reading in itself, does not guarantee that teachers use this knowledge when they design their daily reading lessons. Against this background the aim of the current study is to explore the relationship between teachers' pedagogical content knowledge of reading and the quality of their reading instruction. In this study we assume that teachers' instructional behavior during fluent reading lessons, for a fair part is accounted for by teachers pedagogical content knowledge of reading.

Theoretical and empirical framework

In this section we will elaborate on the subject of reading fluency and on the basic principles underlying the design of a program for reading instruction to enhance fluent reading. Furthermore we will discuss the research on the assessment of teacher knowledge and, more specifically teacher knowledge of fluent reading. Next we will look at the empirical evidence on the relation between teacher knowledge

and their subsequent reading instruction. This section will be concluded with a statement of the research questions.

Reading fluency

To date scholars generally agree that fluency is one of the critical components in the acquisition and further improvement of reading skills (National Institute of Child Health and Human Development, 2000). Research shows that the ability to read fluently is highly correlated with other reading achievement outcomes, among which comprehension (Pinell et al., 1995; Rasinski, 2003, 2010). Fluency is often characterized as the important link between decoding and comprehension (Pikulski & Chard, 2005; Chard, Pikulsky & McDonagh, 2012). Samuels (2012) states that the essence of fluent reading is the ability to decode and to comprehend text at the same time.

An important question to be raised is how to develop fluent reading skills. Research shows that only the frequent reading of large pieces of text leads to the development of reading fluency (Allington, 2009; Snow, Burns, & Griffin, 1998). This means that fluency is not a dichotomous variable, not a skill you either do or do not possess. Fluency is a developmental variable, a skill that develops gradually under the influence of practice (National Institute of Child Health and Human Development, 2000; Rasinski, 2003). The results of correlational studies stress that the most important difference between poor readers and skilled readers is the amount of time they spend on reading (Allington, 2009; Cunningham & Stanovich, 1998; Krashen, 2004; Samuels, 2006). This means that the most important assignment in education is to ensure that all students engage in reading and keep engaged in reading during their entire school career (Houtveen et al., 2012).

An important prerequisite in engaging all students is their motivation for reading. Wigfield and Guthrie (2000) found that students who were intrinsically motivated for reading, were much more likely to report that they engaged frequently in reading. At the same time we know that intrinsic motivation for learning tends to decrease across the school years (Eccles, Wigfield, & Shiefele, 1998; Gottfried, Fleming, & Gottfried, 2001; Wigfield & Eccles, 2002). Thus it becomes even more important to continuously keep students motivated for reading. Since students' self-efficacy proves to be strongly correlated with student's motivation for school and with learning achievement (Bandura, 1997), it is extremely important to let students know they did well in reading tasks and to provide them with adequate feedback and encouragement. Research has shown that, in general, children with high self-efficacy beliefs engage in more difficult activities, achieve better in different task and tend to persist even when tasks are complicated (Bandura, 1997; Schunk & Zimmerman, 1997). Research in the field of reading has shown that children who received training to enhance their reading self-efficacy and strategy use were higher achievers in reading (Schunk & Rice, 1993).

Basically there are two modes of instruction to be distinguished in promoting fluency: oral reading and silent reading. In oral reading students read text passages out loud, if necessary with help or support of others. Empirical evidence was found for the influence of different oral reading procedures in endorsing fluency (National

Institute of Child Health and Human Development, 2000; Samuels & Farstrup, 2006). In silent reading approaches students are encouraged to read texts silently for themselves with a minimum of help and support. Reviews show significant correlations between silent reading and reading achievement (Anderson, Hiebert, Scott, & Wilkerson, 1985; Cunningham & Stanovich, 1998; Nathan & Stanovich, 1991; Stanovich, 1986). Furthermore empirical evidence for the importance of silent reading was found in experimental studies (Reutzel, Fawson, & Smith, 2008; Reutzel, Petscher, & Spichtig, 2012). An important argument in favor of the application of silent reading approaches is that silent reading rates exceed oral reading rates. It was found that, compared to oral reading approaches, in silent reading on average 30% more text is read in the same amount of time (Hasbrouck & Tindal, 2006; McCallum, Sharp, Bell, & George, 2004).

Once students have developed the ability to quickly and accurately recognize the more familiar words in a text, they possess basic fluency skills (Pikulski & Chard, 2005). It is important to recognize the basic principles which can lead to instructional routines in order to further develop reading fluency. First and foremost, the children should be offered ample opportunities to read (Allington, 2009; Rasinski, 2003; Samuels, 2006). Research shows that, within the daily scheduled reading lessons, children should spend a minimum of 20 min on reading age-appropriate texts (Pikulski & Chard, 2005). A second important principle is the modelling of fluent reading behavior, where teachers provide their students with a sense of what reading should sound like (Chard, Vaughn & Taylor, 2002; Rasinski, 2003; Reutzel, Fawson & Smith, 2008). A third and last important principle is the scaffolding of engaged reading behavior. Teacher can offer support to those children who are facing problems in staying engaged in reading or in choosing appropriate books to read (Rasinski, 2003). Teachers also offer support in short one-on-one conversations, where they see to it that their students are sure of themselves as readers and believe in their own capacities to be a proficient reader (Guthrie, 2011).

The assessment of teachers' knowledge of reading

Although there is a growing body of research on teacher knowledge, the empirical evidence on teacher's knowledge of fluent reading is still sparse. In a study to evaluate the efficacy of an intensive form of professional development Brady et al. (2009) used a 60-item teacher knowledge survey (TKS). Six of the included items addressed the importance of fluency for reading success, goals for fluency in the first grade and ways to improvements in fluency. Unfortunately the reliability of the scale with fluency items was low at both measurements (respectively, $\alpha = .38$ and $\alpha = .16$). The reliability of the TKS however, proved to be moderate on the first measurement ($\alpha = .63$) and high on the second measurement ($\alpha = .81$). The results in this study indicated a weak knowledge prior to the professional development course and a large and significant gain by year end. In another study 117 kindergarten through Grade 3 teachers completed a survey of knowledge about reading fluency that consisted of five open-ended questions (Lane et al., 2008). The questions tapped the definition of fluency, the importance of developing fluency, knowledge and skills needed to become a fluent reader, the assessment of fluency

and lastly instructional methods to promote fluency. In this study each of the five questions on teacher knowledge was used as a separate independent variable, which means that this study did not yield to a single reliable measure for the participating teachers' level of knowledge of fluent reading. Further analyses using latent growth models indicated that, in general, teachers who knew more taught children who read quickly and accurately, which led the researchers to the conclusion that teacher knowledge about reading fluency matters.

Considerably more evidence, on the other hand, is gathered on teachers' knowledge of linguistic structures and basic components of the reading process. Moats (1994) argued that teachers do not become fully aware of the structure of spoken language and of its relationship to writing, just because of the fact that they themselves have developed into experienced readers. The 89 literate and experienced teachers participating in an "Informal Survey of Linguistic Knowledge" demonstrated insufficient knowledge of the spoken and written language structure to teach it properly to beginning readers or readers with reading and/or spelling disabilities (Moats, 1994).

Since then the "Informal Survey of Linguistic Knowledge," in its original or an adapted form, has been widely used in other studies, almost always leading to the conclusion that the participating teachers showed only limited knowledge of phonological awareness, language structure and phonics (Bos et al., 2001; Cheesman, McGuire, Shankweiler, & Coyne, 2009; Cunningham et al., 2004; Fielding-Barnsley & Purdie, 2005; Mather, Bos, & Babur, 2001; McCutchen et al., 2002a, b, 2009; Moats & Foorman, 2003; Piasta et al., 2009; Spear-Swerling & Brucker, 2003; Spear-Swerling et al., 2005). Some of these studies reported that in-service teachers had a significantly higher level of knowledge than did preservice teachers (Bos et al., 1999; Fielding-Barnsley & Purdie, 2005; Mather et al., 2001), while others stated that more experienced teachers demonstrated a higher level of knowledge than teachers who were relatively new to the profession (Bos et al., 1999; Spear-Swerling et al., 2005). Furthermore, several studies have shown that knowledge of linguistic structures and basic components of the reading process can be deepened by professional development (Bos, Mather, Narr, & Babur, 1999; Spear-Swerling & Brucker, 2004; Spear-Swerling, 2009; McCutchen et al., 2002a, 2009; Brady et al., 2009).

Although knowledge of the linguistic foundations of reading is important, it is only one of several domains of specialized knowledge that teachers might need in order to teach reading effectively. To date it is generally accepted that engaging children in high quality literature is beneficial in developing literacy. In order to create and maintain a literate environment and to be able to support their students in choosing appropriate books, knowledge of children's literature seems an imperative condition for teachers. Research in this field, however, shows somewhat conflicting results. A vast majority (90%) of 722 kindergarten through third grade students involved in a study by Cunningham et al. (2004), for instance, were not familiar enough with the most popular books for children to recognize even a majority of titles. McCutchen et al., (2002b), on the other hand, reported that 59 kindergarten and Grade 1 and 2 teachers involved in their study were familiar with over 80% of book titles appropriate for use with first graders.

Other researchers described the knowledge that teachers need to teach reading efficiently as “engaged knowledge” (Carlisle, Correnti, Phelps, & Zeng, 2009; Phelps & Schilling, 2004). Following this line of reasoning Brownell et al. (2009) assessed teachers engaged knowledge related to word analysis and comprehension. The results from their study revealed that the participating 34 beginning special education teachers on average had a fair degree of knowledge for teaching reading, only slightly lower than the average scores of a comparison group of elementary education teachers (Brownell et al., 2009).

Relating teacher knowledge and provided reading instruction

The empirical evidence relating teacher knowledge and provided reading instruction is still sparse and for the major part directed at the domain of beginning reading. In the available studies, the concept of teacher knowledge was assessed in different groups of teachers, teaching kindergarten through fifth grade and in groups of teachers in different phases of their professional career. The provided reading instruction was assessed either by looking at different instructional activities that teachers engaged their students in (e.g., McCutchen et al., 2002b), or the amount of time that teachers engaged their students in these different instructional activities (e.g., McCutchen et al., 2002a, 2009; Piasta et al., 2009). In some studies classroom observations were used to gather the required data (e.g., Brownell et al., 2009; McCutchen et al., 2009). Other studies used teacher self-report forms as an indication of the different instructional activities teachers use in their lessons, or the amount of time teachers would prefer to spend on different instructional activities (e.g., Cunningham, Zibulsky, Stanovich, and Stanovich, 2009; Spear-Swerling & Zibulsky, 2014).

Taking all these methodological differences into account, the empirical evidence from the aforementioned studies still leads to somewhat conflicting results. In some studies significant correlations were found between aspects of teacher knowledge on the one hand and the use of explicit phonological activities (McCutchen et al., 2002a, b; Spear-Swerling & Zibulsky, 2014), the use of vocabulary activities (McCutchen et al., 2009) and the use of comprehension strategies (McCutchen et al., 2002a) on the other hand. Other results seem to lead in an opposite direction, either showing that teachers’ knowledge was not significantly correlated to classroom practice (Brownell et al., 2009) or not being able to predict the amounts of explicit decoding instruction that was provided (Piasta et al., 2009). Furthermore, there were no significant differences found in the preferred time allocation in groups of teachers with either high or low knowledge levels (Cunningham et al., 2009).

In this group of studies empirical evidence relating teacher knowledge and classroom activities in supporting fluent reading is sparse, or even absent. In an evaluation study of reading first schools in Florida for instance, Lane et al. (2008) engaged 117 kindergarten through grade three teachers in a survey composed of five open-ended questions. In one of these question teachers were asked to identify the method of teaching they normally used in fluency instruction. The most common methods teachers identified were modeling fluent reading, repeated readings, practicing with peers, timed reading, choral reading and readers’ theatre. The

researchers argued that a certain level of knowledge of these effective instructional methods ought to be important in the selection and implementation of those methods. Since this study was not focused on the actual instructional behavior of the participating teachers, no further information was presented about the instructional activities that were actually employed in classroom practice. Another example is a study by Spear-Swerling and Zibulsky (2014), who engaged 102 fifth-grade general and special education teachers to examine how their knowledge base for teaching reading related to how they would choose to allocate time in a 2 h language arts block. Teachers were asked to specify their preferences for time allocation using an open grid on which they listed descriptions of planned instructional activities and the amount of time for each of these activities for a 2 h language arts block. The results of this study revealed that teachers' knowledge of phonemic awareness and phonics was positively correlated with time teachers allocated for activities regarding phonemic awareness and phonics. Additionally, teachers' knowledge of fluency, vocabulary and comprehension was correlated with their time allocation in relation to the oral language/literature composite, but not with their time allocation in other areas where a relationship was expected, such as vocabulary or reading comprehension. The researchers concluded that teacher knowledge did predict teachers' time allocation plans, particularly for teachers with relatively high knowledge of phonemic awareness and phonics.

The current study

In the forgoing paragraphs reading fluency is positioned as one of the critical components of skilled reading. Scholars acknowledge that, in order to help their students become fluent readers, teachers ought to dispose of a vast body of specialized knowledge. Although teachers' knowledge of linguistic structures and basic components of the reading process has been studied extensively, far less is known of teachers' knowledge of reading fluency. Furthermore we have seen that empirical evidence relating teacher knowledge and provided reading instruction for the major part is directed at the domain of beginning reading. Empirical evidence relating teacher knowledge and classroom activities in supporting fluent reading is sparse, or even absent at all. The current study is aimed at exploring the relationship between teachers' pedagogical content knowledge of reading and the quality of their reading instruction. The research questions in this study are: What is the level of teachers' pedagogical content knowledge of reading? To what extent teachers' instructional behavior during fluency lessons is accounted for by teachers' pedagogical content knowledge of reading?

Method

Respondents

The present study was conducted on a sample of 109 teachers, at 19 schools for primary education in the Netherlands. About three-quarters of the group of

participating teachers was female. There was an equal division of teachers in the age group up to 40 years of age and those aged over 40. A large part of the sample (36%) consisted of experienced teachers with over 20 years of professional experience. There was also a fair group of teachers (29%) at the beginning of their professional career as a teacher, having up to 5 years of professional experience. The rest of the sample was almost equally divided into a group of teachers who had worked in education for 5–9 years (17%) and a group of teachers with 10–19 years of professional experience (18%).

All of the participating teachers were assigned to reading classes with students possessing basic fluency skills. In other words, these students all were able of quickly and accurately recognizing the more familiar words in a text. All of these students had shown to be able to accurately read at a speed of at least 100 words per minute, assessed with a frequently used standardized text reading test. Based on these reading assessments the students were assigned to a silent reading condition.

Variables

Teachers' pedagogical content knowledge of teaching reading was assessed with a questionnaire consisting of 38 dichotomous items that were presented as statements. The respondents had to indicate whether or not they would agree with the presented statement. The results of an earlier study indicated that the questionnaire fulfilled the assumptions of a Raschmodel (Van den Hurk et al., 2012). Part of the items concerned the knowledge of the foundations of fluency: oral language skills, phonemic awareness, familiarity with letter forms and efficient decoding skills. Examples of items in this category are: "Engaging students in writing activities in kindergarten has a positive effect on reading skills" and "Simultaneously presenting letters and sounds improves letter recognition". Another group of items focusses on supporting and scaffolding fluent reading behavior. Examples of items in this category are: "The reading speed of slow readers can be accelerated by introducing scaffolds like partner reading" and "Round Robin practice stimulates fluent reading behavior". A last group of items is aimed at enhancing reading motivation. Examples of items in this category are: "Allowing students to read books of their own choice has a positive effect on their reading motivation" and "Reading comic books has a positive effect on pupil's reading motivation".

The quality of the reading instruction the teachers provided, was assessed with two standardized event sampling observation instruments. One of the instruments, containing six items, measured the teachers' modelling of fluent reading behavior. Some examples of the items that were used are: "The teacher reads aloud a short section of the book he/she introduced before" and "The teacher uses think-alouds". The second instrument, consisting of three items, assessed the teachers support during the fluent reading practice. The items that were used in this instrument are: "The teacher interacts with pupils about the book they are reading," "The teachers supports the pupils while choosing an appropriate book" and "The teacher ensures that the pupils continue reading". All of the items were scored on four answer modalities according to the extent the targeted behavior was present in the observed lesson: 0 = never, 1 = seldom, 2 = usually, 4 = always. The observational

instruments were adopted from earlier studies, where both homogeneity and interrater reliability were tested. In several studies Cronbach's α varied between .73 and .92 and Hubert's κ varied between .75 and .82 (Houtveen & Booij 1994, Houtveen et al., 2012; Houtveen & Van de Grift 2012).

Teachers' pedagogical behavior was measured by a third event sampling instrument, containing nine items. To be more precise, this instrument assessed the way teachers are fostering pupils' feelings of competence and self-efficacy. Some examples of the items that were used are: "The teacher is patiently awaiting pupils' answers" and "The teacher shows faith in his/her pupils". Again, all of the items were scored on four answer modalities according to the extent the targeted behavior was present in the observed lesson: 0 = never, 1 = seldom, 2 = usually, 4 = always. This third observational instrument was adopted from an earlier study by Houtveen & Booij (1994). In several other studies where this instrument was used, both Cronbach's α and Hubert's κ were .70 and exceeding (Houtveen & Booij 1994; Houtveen et al., 2012).

Procedures

The data were collected on schools voluntarily participating in a school improvement project on reading in the schoolyear 2010–2011 (Houtveen et al., 2012). The school improvement project was carried out under the responsibility of the Department of Literacy of the Utrecht University of Applied Sciences in the Netherlands. The fluent reading lessons in this project typically lasted 35–45 min and followed a strict structure in which teachers typically started out with reading aloud a short section of a book, than initiating a specific topic in a mini-lesson, subsequently having all pupils read in their own books for at least 20 min and finally concluding the session with a retrospective of the passed activities. This model was introduced in team meetings and successfully implemented in the schoolyear before the questionnaires were administered and the observations were conducted (Houtveen et al., 2012).

Every single school was supervised by an experienced school advisor. Prior to the start and during the project all school advisors were trained by members of the project staff of the Department of Literacy. From the 23 school advisors who initially started the training, 19 eventually were assigned to supervise one of the participating schools. As an observation training was one of the recurring subjects in the training sessions, it is ensured that all the participating school advisors were proficient in the use of use the standardized observation instruments. The school advisors visited the school to conduct the observations and to discuss the results of these classroom observations with the observed teachers. The classroom observations were carried out at about the same time of the schoolyear the questionnaires were administered.

During the project all of the participating teachers individually filled out a questionnaire on their pedagogical content knowledge of reading. The questionnaires were administered digitally which made it possible to record all the answers and, at the same time, to provide feedback reports for the participating teachers.

Results

In the current study the psychometric quality of the observation scales was again checked and descriptive analyses were conducted. Since earlier research indicated that the teacher questionnaire fulfilled the assumption of a Raschmodel (Van den Hurk et al., 2012), the reliability of the questionnaire was not checked again. As shown in Table 1, the internal consistency of the observation scales reached an acceptable level, are varying from $\alpha = .70$ up to $\alpha = .80$. The participating teachers demonstrated a fair level of pedagogical content knowledge of reading ($M = 1.44$, $SD = .69$). The average score for modeling fluent reading was $.75$ ($SD = .26$), indicating that teachers, on average, displayed 75% of the targeted behavior during the observed lessons. Highest average mean scores were reached for fostering competence and self-confidence ($M = .83$, $SD = .15$). Lowest mean scores were reached for supporting fluent reading. Furthermore it is noticeable that the scores on this scale varied about one-third of a standard deviation ($M = .63$, $SD = .34$). All three of the observation measures showed left-tailed distributions (see also “Appendix”).

An independent-samples *t* test was conducted to compare the level of pedagogical content knowledge of reading with the group of teachers participating in our earlier study (Van den Hurk et al., 2012). No significant differences were found comparing the level of knowledge of the teachers in the earlier sample ($M = 1.47$, $SD = .80$) and the level of knowledge of the group of teachers participating in the current study ($M = 1.44$, $SD = .69$; $t(322) = .384$, $p = .70$, two-tailed).

In order to study the relationship between teachers’ pedagogical content knowledge of reading and the displayed teacher behavior during fluent reading a confirmatory factor analysis model was developed and estimated using LISREL8 (Jöreskog & Sörbom, 1993). The path diagram of this confirmatory factor analysis model that was used in this study is depicted in Fig. 1. The developed model contains four observed variables and two factors. The latent variable, or factor, of teachers’ pedagogical content knowledge for teaching reading, is indicated by one measured variable, namely the results on a teacher questionnaire. The latent variable of teacher behavior during fluency instruction is indicated by three observable variables, namely: teachers’ modelling of fluent reading, teachers’ support of fluent reading and teacher behavior fostering students’ feelings of competence and self-efficacy. In order to answer the research question to what extent teachers’ instructional behavior during fluency lessons is accounted for by teachers’

Table 1 Descriptive measures and internal consistency of the observation scales (n = 109)

	Number of items	Cronbach’s alpha	Mean	SD
Teacher knowledge	–	–	1.44	.69
Modelling fluent reading	6	.78	.75	.26
Supporting fluent reading	3	.80	.63	.34
Fostering competence and self-confidence	9	.70	.83	.15

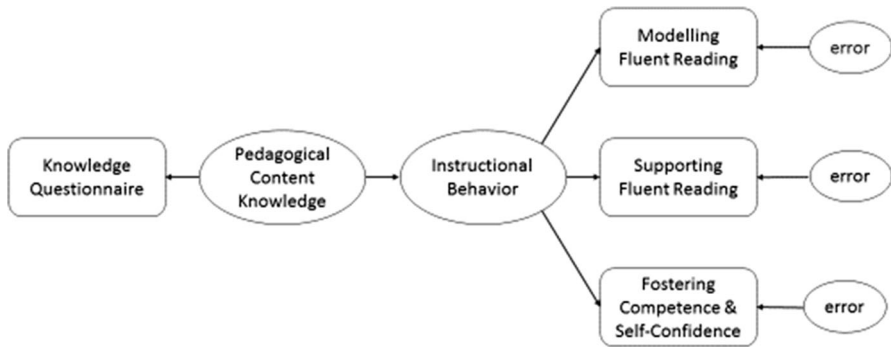


Fig. 1 Confirmatory factor analysis model

pedagogical content knowledge of reading, the latent variable of teachers' pedagogical content knowledge was included as an exogenous variable. Since we do not assume that the latent factor of teachers' instructional behavior completely explains the variation in the three observed variables, each of these variables is associated with a residual error term. In determining how well the a priori model fits the sample data several absolute indices were used.

To evaluate the overall model fit, the Chi square statistic was used, which assesses the magnitude of discrepancy between the sample and fitted covariance matrices (Hu & Bentler, 1999). In order to reach an acceptable goodness-of-fit measure, the Chi square significance value should be greater than .05 (Barrett, 2007). As a second statistic the root mean square error of approximation (RMSEA) is used. The RMSEA is providing information as to how well the model would fit the populations' covariance matrix (Byrne, 1998). Although different RMSEA cut-off points have been used in the last decade, it is generally agreed upon that models with RMSEA values less than .05 are considered to have a good fit. Models with RMSEA values ranging from .05 to .08 are considered to have a reasonable fit, whereas models with RMSEA values of .10 or higher suggest poor fit (Hu & Bentler, 1999; Kline, 2005). To calculate the proportion of variance that is accounted for by the estimated population covariance, the goodness-of-fit index (GFI) was used (Jöreskog & Sörbom, 1993; Tabachnick & Fidell, 2007). For the GFI a cut-off point of .95 is seen as appropriate in regard of the relatively small sample size of our study (Miles & Shelvin, 1998). Adjusting the GFI, based upon the degrees of freedom, leads to the adjusted goodness-of-fit (AGFI), where a value of .90 or higher is generally accepted as an indication of a well-fitted model (Tabachnick & Fidell, 2007). Additionally a relative fit index was used which is different from the aforementioned absolute fit indices. For relative fit indices the null hypothesis is that all variables are uncorrelated (McDonald & Ho, 2002). The normed fit index (NFI), that was traditionally used, compares the models' Chi square value to the Chi square value of the null model. This null model is a worst case scenario since it specifies that all measured variables are uncorrelated. Since research has indicated that this normed fit index is sensitive for sample size we decided to use the comparative fit index (CFI), a revised form of the NFI, which also

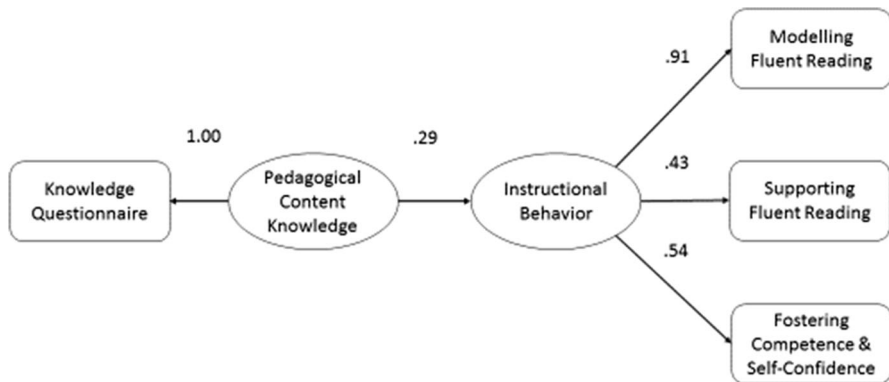


Fig. 2 Estimated factor loadings; fit indices: Chi square = .71, $df = 2$ ($p = .70$), RMSEA = .00, GFI = 1.00, AGFI = .98, CFI = 1.00

has shown to perform well in studies with relatively small sample sizes (Tabachnick & Fidell, 2007). To date values for CFI of .95 and higher are seen as an indicator of good fit (Hu & Bentler, 1999). The fit of the model was good: Chi square = .71, $df = 2$ ($p = .70$), RMSEA = .00, GFI = 1.00, AGFI = .98, CFI = 1.00, which means that the proposed model is a plausible model for the data that were gathered in this study.

The estimates of the factor loadings are presented in Fig. 2. The results show that the variance in modelling of fluent reading for a large part is explained by the latent factor of teacher behavior in fluency instruction ($\lambda = .91$). To a lesser extent the variance in teacher behavior which is fostering students competence and self-efficacy is explained by the latent factor of teacher behavior in fluency instruction ($\lambda = .54$). And lastly teachers' support of fluent reading behavior is only for a small proportion accounted for by the latent factor of teacher behavior in fluency instruction ($\lambda = .43$). The association between the exogenous variable, pedagogical content knowledge for teaching reading and the endogenous variable, teacher behavior during fluency instruction is expressed in the γ -value. The γ -value of .29 that was found in this study, indicates that 8% of the variance in teacher behavior in fluency instruction is accounted for by teachers' pedagogical content knowledge for teaching reading. This means that teachers' behavior in fluency instruction is only for a very small proportion accounted for by teachers' pedagogical content knowledge for teaching reading.

Conclusion and discussion

In this study we looked at the relationship between teachers' pedagogical content knowledge of reading and their classroom behavior in teaching fluent reading. Knowing that teachers need to dispose of a vast body of specialized knowledge to teach reading efficiently (e.g., Callahan et al., 2009; Lyon & Weiser, 2009; Moats, 2009), we wondered whether these teachers would use this specialized knowledge in

their practice of teaching. Against this background a first research questions into the level of teachers' pedagogical content knowledge of reading, was posed. In order to answer the first question, descriptive analyses were performed. Secondly we wanted to find out to what extent teachers' pedagogical content knowledge of reading accounted for differences in their instructional behavior during fluency lessons. We anticipated that teacher practice at least for a fair part could be explained for by teachers' pedagogical content knowledge of reading. In order to answer the second research question a confirmatory factor analysis model was developed with two latent variable. In this model the factor of teachers' pedagogical content knowledge of reading was measured by the results on a teacher questionnaire. The factor of teachers' classroom behavior during fluency instruction was measured by three observable variables: modelling of fluent reading, support of fluent reading and fostering students feelings of competence and self-efficacy.

The participating teachers, on average demonstrated a fair level of pedagogical content knowledge of reading, as assessed with our teacher questionnaire. The assessment of the quality of teachers reading instruction and the quality of teachers' pedagogical behavior, also yielded positive results. The left-tailed distributions of the observational measures (see "[Appendix](#)") are probably caused by the use of a scripted lesson model, where teachers were tempted to employ the targeted behavior whenever possible.

The estimated fit of the presented model was good (Chi square = .71, $df = 2$; $p = .70$, RMSEA = .00, GFI = 1.00, AGFI = .98, CFI = 1.00), which means that the proposed model is a plausible model for the data that were gathered in this study. The significant γ -value of .29 indicates that 8% of the variance in teacher behavior in fluency instruction is accounted for by teachers' pedagogical content knowledge for teaching reading. This means that, contrary to our expectations, only a very small proportion of the variance in teacher behavior in fluency instruction is accounted for by teachers' pedagogical content knowledge of reading, as it was assessed with the teacher questionnaire that was used in this study. The obtained result are suppressed by the fact that all three of the observation measures showed left-tailed distributions (Dunlap, Burke & Greer, 1995; Norman, 2010).

Compared to the results of our earlier research the teachers in the current study demonstrated the same level of pedagogical content knowledge reading. In our earlier study we found that teachers typically have a better knowledge of what works in teaching reading than of what does not work in teaching reading (Van den Hurk et al., 2012). This could mean that teachers' knowledge base is not as stable and conclusive as one might think. More research is needed to determine the factors that seem to work restricting for teachers in putting their knowledge into classroom practice.

Attempts to compare the results of the present study with findings of previous research leads to different kinds of problems. As we have stated before, in previous studies the concept of teacher knowledge was operationalized and measured in different ways. Some studies looked at teacher knowledge of linguistic structures and basic components of the reading process, assessed with some form of the Teacher Knowledge Survey (Bos et al., 2001; Cheesman et al., 2009; Cunningham et al., 2004; Fielding-Barnsley & Purdie, 2005; Mather et al., 2001; McCutchen

et al., 2002a, b, 2009; Moats, 1994; Moats & Foorman, 2003; Piasta et al., 2009; Spear-Swerling & Brucker, 2003; Spear-Swerling et al., 2005). Other studies focused on knowledge of word analysis and comprehension in an attempt to assess what they called engaged teacher knowledge (e.g., Brownell et al., 2009). In some of the studies we found, attention was paid to teachers' knowledge of children's literature (e.g., Cunningham et al., 2004; McCutchen et al., 2002b). In many studies samples of participating teachers consisted of pre-service or novice teachers (e.g., Brownell et al., 2009; Cheesman et al., 2009; Fielding-Barnsley, 2010; Spear-Swerling, 2009; Spear-Swerling & Brucker, 2003, 2004; Spear-Swerling et al., 2005). Furthermore, teacher knowledge was assessed in different groups of teachers, teaching kindergarten through fifth grade and in groups of teachers in different phases of their professional career. Most important however, is that there are nearly no other studies that focused on the relation of teacher knowledge and the subsequent fluent reading activities these teachers displayed in their classroom. This having said it can be stated that the results of the current study seem to be in line with results of Brownell et al. (2009) who found that the proportion of explained variance in overall classroom practice and four of the five subscales was small, contributing less than 10% of the variance in performance on each of the scales for teacher practice. From these results the researchers concluded that domain expertise does not play a strong role in the classroom practice of beginning special education teachers (Brownell et al., 2009). The results of the current study suggest that the same conclusion also holds for more experienced teachers working in general education.

It should be noted however that we were only able to engage a relatively small sample of 109 teachers in the current study. As a rule of thumb for structural equation modelling sample sizes of 200 observations seem reasonable (Hox & Bechger, 1998; Shevlin & Miles, 1998). Therefore it seems to be worthwhile for a next study to engage a larger sample of participating teachers. Also worthwhile noticing is the fact that our sample of teachers was drawn from schools participating in a reading improvement program. The teachers in this program were using a specific lesson format. The application of this prescribed lesson format could mean that the influence of teachers' knowledge on their instructional practice by definition was limited. It could be worthwhile to repeat the study in a sample of teachers not being influenced by a specific lesson format. Furthermore it is obvious that the ultimate goal of efficient reading instruction is to yield experienced fluent readers. For further research it seems appropriate to investigate the relation of teacher knowledge with teachers' classroom behavior and the influence of both variables on students' reading achievement.

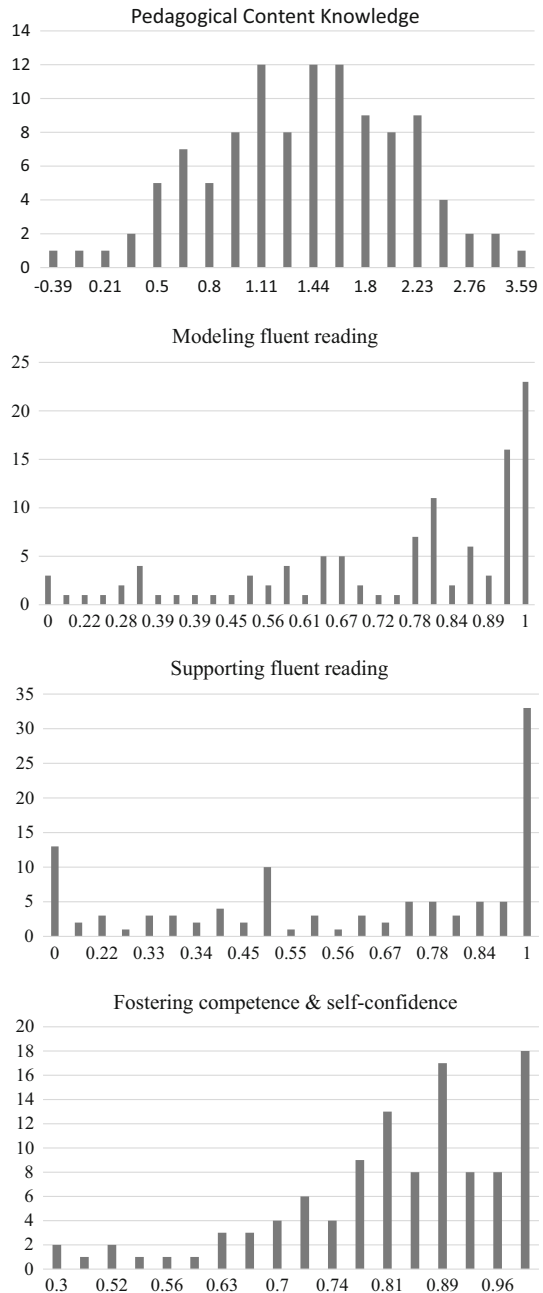
In our view the importance of teachers' pedagogical content knowledge of reading stays without discussion. Nevertheless, the results of the current study show that the activities teachers apply in their fluent reading lessons only for a very small proportion depend on teachers pedagogical content knowledge of reading. As a consequence the focus in preservice and in-service teacher training should not be limited to transfer of knowledge but should preferably address the application of this knowledge base in designing and performing fluent reading instruction.

Appendix

See Fig. 3.

Fig. 3 Frequency distributions of teacher measures

Frequency distributions of teacher measures



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