Routledge
Taylor & Francis Group

Early Education and Development

ISSN: (Print) (Online) Journal homepage: https://www.tandfonline.com/loi/heed20

Mind Mapping during Interactive Book Reading in Early Childhood Classrooms: Does It Support Young Children's Language Competence?

Inouk Boerma, Femke van der Wilt, Renske Bouwer, Menno van der Schoot & Chiel van der Veen

To cite this article: Inouk Boerma, Femke van der Wilt, Renske Bouwer, Menno van der Schoot & Chiel van der Veen (2022) Mind Mapping during Interactive Book Reading in Early Childhood Classrooms: Does It Support Young Children's Language Competence?, Early Education and Development, 33:6, 1077-1093, DOI: 10.1080/10409289.2021.1929686

To link to this article: https://doi.org/10.1080/10409289.2021.1929686

Published online: 17 Jun 2021.

EARLY EDUCATION AND DEVELOPMENT
2022, VOL. 33, NO. 6, 1077–1093
https://doi.org/10.1080/10409289.2021.1929686

Routledge
Taylor & Francis Group

Mind Mapping during Interactive Book Reading in Early Childhood Classrooms: Does It Support Young Children's Language Competence?

Inouk Boerma[a], Femke van der Wilt[b], Renske Bouwer[b], Menno van der Schoot[b], and Chiel van der Veen[b]

[a]Section of Educational Sciences, and LEARN! Research Institute, Faculty of Behavioural and Movement Sciences, Vrije Universiteit Amsterdam; [b]Department of Education, iPabo University of Applied Sciences

ABSTRACT

Research has shown that interactive book reading in early childhood classrooms contributes to children's language development. High quality interaction during book reading has been shown to be even more beneficial for children's language development, but more research is needed on which interaction practices really work, as there is great variability. The present study investigated the effects of three different interactive book reading approaches in an 8-week intervention: (1) interactive book reading (comparison condition), (2) book reading with focused attention, and (3) book reading using mind maps. A total of 551 children aged 4–6 years from 23 early childhood classrooms participated in the current randomized quasi-experimental study. Multilevel models were used to examine differences between conditions and/or gains in children's language competence. *Research Findings:* Results showed no significant differences between the three interactive book reading conditions, and no added effect of using mind maps during interactive book reading. However, our study does show that engaging young children in three different and relatively short interactive book reading interventions results in improved language competence. *Practice or Policy:* Findings confirm the importance of interactive book reading in education and indicate that teachers can alternate on traditional interactive reading, for example, by using mind maps.

The Practice of Interactive Book Reading

Reading books to young children is an important activity both at home and at school. It has been shown to contribute to various aspects of children's language and reading development, such as vocabulary and oral language skills (e.g., Mol & Bus, 2011; Mol et al., 2008; Sénéchal & LeFevre, 2002; Wasik & Bond, 2001), early literacy skills (e.g., Bracken & Fischel, 2008; Mol et al., 2009), listening comprehension (Sénéchal & LeFevre, 2002), and reading motivation (Sénéchal, 2006). Fortunately, book reading is a common practice in most early childhood classrooms. For example, more than 90% of Dutch early childhood teachers read to their students at least three times a week, and most of them do this (almost) every day (Ghonem-Woets, 2009). Book reading is even more effective for promoting children's language skills when interaction takes place about the book and the story line (Mol et al., 2008). In early childhood classrooms these interactions usually consist of questions and answers from teachers and children about the events that take place in the story. A recent systematic review highlighted the great variability among interactive reading practices with young children, which demonstrates the need for more research on how to effectively engage children in interactive reading

CONTACT Chiel van der Veen chiel.vander.veen@vu.nl Vrije Universiteit Amsterdam De Boelelaan 1085, Amsterdam, HV 1081, The Netherlands

practices and to better understand which practices are most beneficial in supporting children's language ability (Wasik et al., 2016). In the current study, a specific interactive book reading practice in early childhood education is being examined. We studied the added value of using mind maps during interactive book reading sessions to support children's language competence.

Mind Maps and Interactive Book Reading

A mind map is a particular type of graphic organizer that is used to express the main ideas in a text. The key concept of a story or a text is located in the middle of the page, and several branches radiate out from this key concept to represent the main topics of a text. Smaller branches can be attached to these main branches to indicate related, sub- and superordinate ideas (Budd, 2004; Buzan, 2005; Merchie & Van Keer, 2016a). An important difference between mind maps and most other graphic organizers, such as word webs, is their hierarchical organization. The more "linear" text information is represented in different branches with their own colors and images. Text relations, such as examples or contrasts, are displayed by the use of numbers, symbols, or arrows (Budd, 2004; Buzan, 2005; Merchie & Van Keer, 2016a, 2016b).

Research on the effectiveness of using mind maps in education is limited, but generally positive results have been found (Abi-El-Mona & Adb-El-Khalick, 2008; Budd, 2004; Farrand et al., 2002; Merchie & Van Keer, 2013, 2016a, 2016b). It is thought that mind maps aid children's understanding of text because of their hierarchical organization, in which the main ideas are represented in relation to other text parts. In addition, the connection of words and pictures might lead to dual coding and deeper processing and can also evoke mental imagery in students (Merchie & Van Keer, 2013, 2016a). In previous projects, mind maps have been successfully used as a tool for economics education at a university (Budd, 2004), and as an effective study technique for medical students (Farrand et al., 2002). An experiment in middle school showed that students (13 to 14 years old) who participated in a mind mapping intervention achieved higher gains in science class compared to students in a control group (Abi-El-Mona & Adb-El-Khalick, 2008). Recent research on mind mapping in grade 5 and 6 students (mean age = 11.44 years) in primary school has shown that these students were able to improve their graphical summarization skills after participating in a mind map intervention (Merchie & Van Keer, 2013, 2016a, 2016b). However, to the best of our knowledge no studies have been performed on the use of mind maps in early childhood classrooms. In addition, most studies on mind mapping focus on expository texts as can be found in study books. In our study, we focused on narrative texts that can, for example, be found in picture books.

Why Would Mind Mapping Work?

But why would using mind maps during interactive book reading support children's language skills? Research has shown that adding pictures to a text improves learning and understanding of that text (Eitel & Scheiter, 2015; Levie & Lentz, 1982; Schnotz, 2002). This has been referred to as the multimedia effect (Mayer, 2002). The multimedia effect is based on the idea that readers need to build mental models in order to understand a certain text. When both pictures and words are provided, these mental models can be constructed more easily, because ambiguous information from the text is explained by pictures (Mayer, 2002). In addition, it is thought that the combination of words and pictures results in deeper processing, which is suggested by Paivio's dual coding theory. According to this theory, words and pictures are stored and processed in two separated but connected cognitive subsystems: a verbal system and a non-verbal (imagery) system (Paivio, 2006). A text with pictures requires readers to make associations between verbal and visual information (dual coding), which results in deeper processing and increased understanding. A mind map can support children to connect the verbal and visual information which can facilitate understanding (Merchie & Van Keer, 2013). In addition, the nature of a mind map, with its hierarchical organization, could help clarify the relation between story events, and support children's understanding of the story characters, including

their behavior and emotions. Therefore, we expect that interactive book reading practices in early childhood classrooms in which mind maps are used will increase young children's understanding of the stories and might contribute to their language development, such as vocabulary, as well.

Interactive Book Reading and Early Language Development

Whereas the added benefits of using mind maps during interactive reading practices have not yet been examined (and are therefore the topic of this study), many studies have reported positive relations between interactive book reading practices and young children's language development. During interactive book reading, parents or teachers engage in book discussions with children, in which they ask questions about the story and talk about the characters and events in the story (see for example, Whitehurst et al., 1988). A meta-analysis showed that 8% of the variance in expressive vocabulary could be explained by the frequency of parental interactive book reading (Mol et al., 2008). However, it must be noted that in this meta-analysis only the 2- to 3-year-olds benefitted from interactive reading practices with their parents, whereas the effect on the level of expressive vocabulary was much smaller for the 4- to 5-year-olds. Other studies have looked more specifically into the role of early childhood classroom teachers instead of parents, and they have generally found positive relations between interactive book reading and vocabulary (for example, Barnes & Dickinson, 2017; Sun et al., 2020; Wasik & Bond, 2001), even longitudinally (Dickinson & Porche, 2011; Zucker et al., 2012). Especially engaging children in interactive book discussions *after* reading the book (instead of before or during) proved to be effective (Gonzalez et al., 2014). Furthermore, it has been shown that discussions about the characters' internal states, and relations between the book and other classroom activities elicit relatively complex vocabulary (e.g., Duursma et al., 2008; De Temple & Snow, 2003; Wasik & Bond, 2001).

Besides vocabulary, other aspects of children's language, such as listening comprehension and narrative skills can also be fostered by interactive reading practices (see for example, Lepola et al., 2012; Lever & Sénéchal, 2011; Mol & Bus, 2011; National Center for Family Literacy, 2008; NICHD Early Child Care Research Network, 2005; Sénéchal & LeFevre, 2002; Sénéchal et al., 1998; Van Kleeck, 2008; Zevenbergen et al., 2003). For instance, it was found that children aged five were able to produce better-structured narratives after a short interactive reading intervention (Lever & Sénéchal, 2011). Considering the fact that there is ample evidence for the benefits of interactive book reading, and with Paivio's dual coding theory in mind, it can be expected that using mind maps in the context of interactive reading sessions might support children's language development even more.

Current Study

In the current study, the use of a new approach to interactive book reading in early childhood classrooms – using mind maps during interactive book reading – was examined. This approach was compared to a more traditional approach of interactive book reading that is commonly used in Dutch early childhood classrooms. While it has been shown that interactive book reading contributes to various aspects of children's language development, to the best of our knowledge we do not yet know what the added value of using mind maps during interactive book reading in early childhood classrooms might be. We hypothesize that using mind maps will have added value to children's language development, as the use of mind maps supports children to clarify the story events and the relations between story characters for children. In addition, the use of pictures in mind maps can contribute to dual coding and mental imagery which is thought to contribute to language development and story comprehension as well. The mind mapping approach that is used in the current study consists of two steps: (1) prior to each book reading session, a question is asked to focus children's attention on specific aspects of the story (for example, "who is the story about?", to focus children's attention on the characters in the story), and (2) during the discussion after each book reading session, the teacher made a visual representation of the children's answers. In order to examine the specific value of using

mind maps, with its combination of text and pictures, a third condition was added to the current study, in which the same focus questions were asked as in the mind map condition. In this third condition, however, the focused attention questions were not accompanied by a visual representation, as was the case in the mind map condition. Including this condition allowed us to examine which components of mind maps might be more effective, the visual aspect of the graphical representation or the focused attention. In Appendix A, an overview of all three conditions is given and in the paragraph Design all conditions are described in more detail.

The following research question was addressed: What are the effects of engaging in an eight-week reading intervention using mind maps in early childhood classrooms compared to two common interactive reading practices on various aspects of children's language development? This study will focus on the following aspects of children's language development: (1) children's comprehension of the stories that are read, (2) productive vocabulary, (3) narrative skills, and (4) listening comprehension. We have selected these aspects of children's language development, because we know from previous research that (interactive) book reading is effective for or contributes to these aspects of young children's language development. Three interactive picture book reading interventions are compared: (a) traditional interactive reading (as the default practice in Dutch early childhood classrooms); (b) interactive reading with focused attention; and (c) interactive reading using a mind map. These three conditions are described in more detail in the Method section.

Method

Participants

A total of 551 children (pupils from 23 different teachers) participated in the current study. Children were recruited from eight different primary schools from different areas in the Netherlands. These schools were found by posts on social media, to which teachers could respond. Per school, one to a maximum of five early childhood classrooms took part in the study, with a total of 23 participating classrooms. Teachers could only participate in the study if they worked at least two days a week in the same early childhood classroom. Only one teacher per classroom could participate, and all classrooms from one school were assigned to the same condition. Only regular primary schools (no special needs education schools) were allowed to participate and Dutch was spoken in all classrooms.

Children had been given active parental consent. From the total sample of participants, 17 children were not able to complete any of the questionnaires at the pre- and posttest. These children were removed from the dataset, resulting in a final sample of 534 children (256 boys; 265 girls; 13 missing values).

Most children (70.2%) spoke Dutch at home (63.1% Dutch only, 7.1% Dutch and another language, 29.4% missing values). Children's socioeconomic status (SES) was categorized in low, medium, and high (based on their parents' highest level of completed education) according to the classification of the Center of Statistics Netherlands. In our sample, 29 children (5.4%) came from a low-SES background (primary education, or lowest levels of secondary school), 66 children (12.4%) came from a medium-SES background (vocational education or higher levels of secondary school), and 275 children (51.5%) had a high-SES background (higher professional education or university degree) (30.7% missing values).

Children's average age at the time of the pretest was five years and two months. In the Netherlands, children usually enter early childhood education when they are four years old, while compulsory education starts at the age of five. Children start formal education (Grade 1) when they are on average six years old, but some children are kept back for a year, because they are not considered "school ready" yet. As a consequence, Dutch early childhood classrooms have a relatively wide age range. In this sample, the age of children ranged from 4.00 to 6.89 years old (SD = 0.65).

Design

Classrooms within schools were randomly assigned to one of three book reading conditions: (1) interactive book reading, (2) book reading with focused attention, and (3) book reading using mind maps. Interactive book reading is the default in most Dutch early childhood classroom, as it is part of the teacher education curricula, this condition is considered the comparison condition. Table 1 shows the sample characteristics per condition separately. All three conditions consisted of eight reading sessions in total, in which two books were read (four sessions per book, one session per week). Each session lasted about 15–20 minutes and was led by the classroom teacher. During the first three book reading sessions, the picture book was read to the children. In the fourth week, groups of children played out the story at the story table using props that were related to the story (such as toys). Care was taken that all children got their turn at the story table during this week. Classroom teachers were trained to follow a protocol that was developed for each of the three conditions and that described each book reading session in detail (see Appendix A). Teachers were asked to follow the protocol as closely as possible. All three conditions are explained in short below:

(1) Interactive book reading condition (comparison condition): the books were read repeatedly to the children and before, during, and after reading questions about the story (e.g., *What do you think will happen next? Where did the black rabbit go?*) were discussed with the children. The teacher focused on comprehension of story events and character traits and intentions, while explaining difficult words in the book and discussing important concepts with the children. Most teachers in the Netherlands understand the importance and benefits of interactive book reading in early childhood classrooms, and therefore engage in these reading practices on a regular basis.

(2) Book reading with focused attention condition: the books were read repeatedly to the children, and *prior* to each book reading session, a question was asked to focus children's attention on specific aspects of the story. For example, during the first book reading session children were asked to pay specific attention to the characters in the story, which were then discussed after the teacher had read the book. In this condition, the focus questions were the same as in the mind map condition in order to study the added value of using mind maps.

(3) Mind map condition: the books were read repeatedly to the children, and prior to each reading session, a question was asked to focus children's attention. These questions were the same as in condition 2. However, during the discussion afterward, the teacher made a visual representation of the children's answers. In each reading session, one or two branches of the mind map were created, so that after all three reading sessions a complete mind map of the story had been created. All mind maps had the same structure consisting of four branches: who (characters; first reading session), where (story setting; second reading session), problem, and solution (story plot; third reading session). To ensure comparison across classrooms, teachers were provided with mind maps of the picture books by the research team that they could use as an example. However, they created their own mind maps with the children during the reading session and discussed these with the children.

Materials

Books

The picture books that were used in the current study were "The black rabbit" [Het zwarte konijn] by Philippa Leathers (2015) and 'The competition of tortoise and hare [De wedstrijd van schildpad en haas] by Rian Visser and Tineke Meirink (2017). Both books contain pictures and short sentences and words

Table 1. Sample characteristics per condition.

Condition	*N* schools	*N* classes	*N* students	Mean age *(SD)*	% boys
Interactive book reading	2	7	150	5.24 (0.64)	50.0
Book reading with focused attention	3	6	135	5.19 (0.68)	52.2
Mind map	3	10	249	5.21 (0.65)	46.7

that are suitable for young children's level of language ability. The books are written for young children from the age of three. Appendix B contains a short synopsis of the two books.

Measures

Story Comprehension

Children's understanding of the stories was tested using five story comprehension questions: three were focused on the book "The black rabbit" and two questions were about "The competition of tortoise and hare". Questions were directed at the main events of the stories and aimed to assess whether children understood the links between these events (see Appendix C for details). Scores ranged from 0 to 5 (M = 3.30; SD = 1.20; Cronbach's alpha = .46), as 1 point was given for each question that was answered correctly (i.e., 5 points indicated that all 5 questions were answered correctly).

Productive Vocabulary

Children's productive vocabulary was tested using the Thematic Vocabulary Assessment Test (TVAT; Adan-Dirks, 2012; Van Der Veen et al., 2016). The TVAT measures children's productive knowledge of 20 words and expressions that were selected from the two books that were used in the current study. Each time, children were asked to explain the meaning of the word that was read aloud by the test assistant. To familiarize children with this procedure, they were first asked to explain the meaning of the word "branch" (not part of the test). When children could not explain a word, the test assistant asked them if they had heard the word before or if they knew what it was about. The test assistant did not indicate whether the provided explanations were correct. We used the same selection of words for both the pre- and the posttest, with a scale reliability of respectively .68 and .79. Scores at the pretest ranged from 0 to 12 (M = 3.54; SD = 2.60); scores at the posttest ranged from 0 to 20 (M = 6.68; SD = 3.78).

Narrative Skills

To assess children's narrative skills, we used the Narrative Task subscale of the Cito Language Test for All Children. This is a standardized test that can be used to measure the verbal abilities of children aged 4 to 9 (Verhoeven & Vermeer, 2006). The Narrative Task consists of a series of pictures that together form a story. During test administration, children are asked to tell the story in such a way that someone who cannot see the pictures is still able to understand the story. Children's performance is scored on 16 elements that refer to coherence and cohesion of the text. The test has been approved by the Dutch test evaluation committee (COTAN) and has proven to be reliable with Cronbach's alphas for children in early childhood classrooms between .89 and .91 on this subtest (Verhoeven & Vermeer, 2006). Cito has developed two versions of the Narrative Task, which allowed us to use a comparable version at pre- and posttest. In this study, the scale reliability of both tests was acceptable, with a Cronbach's alpha of 0.70 for the pretest and 0.63 for the posttest. Scores ranged from 0 to 16 on the pretest (M = 7.98; SD = 2.95) and from 1 to 16 on the posttest (M = 8.90; SD = 2.69).

Listening Comprehension

Children's listening comprehension was measured using a standardized test for language assessment in early childhood education (Cito Language for Kindergartners; Lansink, 2009), that is used in most primary education school in the Netherlands, including the participating classrooms. This standardized test was approved by the Dutch test evaluation committee as well. In all participating schools the test for listening comprehension had already been administered before the start of the study, so the results were provided by the schools. The test is administered group-wise according to the test instruction manual.

The complete test consists of various subtests, of which the critical listening skills subtest is one. In this test, the teacher reads a short story (3–7 sentences) to the children and the children have to indicate which picture (out of four) is related to the story by drawing a line under the picture that best represents the story. For example, in one item the teacher reads the following

short story: "It is snowing. Daan and Loes are making a snowman. Draw a line under that picture". Four versions of this test have been developed: two for the youngest children in kindergarten (four- and five-year-olds; one version that can be administered during the school year (version M1), and one that can be administered toward the end of the school year (version E1)), and two for the oldest children (five- and six-year-olds; one version that can be administered during the school year (version M2), and one that can be administered toward the end of the school year (version E2)). Following the instructions of the test manual, children's listening comprehension was assessed using a subtest consisting of 15 items. For the youngest children, we used version M1 as pretest and version E1 as posttest. For the oldest children, we used version M2 as pretest and version E2 as posttest. The internal consistency of the items in the pretest for both age groups was .58, with scores ranging from 1 to 15 (M = 11.62, SD = 2.33). In the posttest, the internal consistency of the items was .54, with scores ranging from 5 to 15 (M = 12.74, SD = 1.95).

Procedure

The Story Comprehension Test, the TVAT (productive vocabulary test) and the Narrative Task were administered to all children individually by the research assistants, while the test for listening comprehension was administered group wise by the classroom teacher according to the instructions of the test manual. All tests, except for the Story Comprehension Test, were administered both prior to and after the intervention.

Data Analysis Plan

Missing Data

Data were analyzed using the Statistical Package for Social Scientists (SPSS, version 23). With regard to the main variables (pre- and post-measurements of productive vocabulary, narrative skills, listening comprehension and the single measurement of story comprehension), 10.88% of the values were missing (item level). In particular, for the productive vocabulary and narrative skills measures, the pretest included respectively 9.73% and 9.68% missing values, and the posttest respectively 8.63% and 8.46%. As the listening Comprehension was administered by the classroom teachers, this measure included more missing values with 12.83% for the pretest and 18% for the posttest. Little's MCAR test indicated that the data were not missing completely at random (MCAR), $X^2(4356) = 4603.22$, $p = .005$. However, missing data were beyond our control (e.g., children were not at school because of illness, moved to another school or class, etc.) and, therefore, the distribution of missing values is unknown (cf. Schafer & Graham, 2002). We decided to assume our data to be missing at random (MAR). Although this assumption cannot be assessed, it has been demonstrated that a false assumption of MAR hardly influences the estimates and standard errors for the means at pre- and posttest. Furthermore, replacing missing values was necessary as analyses required complete and comparable datasets and adequate power of the statistical tests. Missing values were therefore imputed using the commonly used Expectation-Maximization (EM) method in SPSS. The imputed dataset was used in subsequent analyses.

Assumption of Normality

A visual inspection of the data indicated that the scores on the main variables were not all normally distributed. To further investigate the distribution of these scores, skewness and kurtosis values were obtained and confirmed that the data did not always follow a normal distribution (see Table 2). This was especially prominent for the pre- and posttests of listening comprehension. Although the assumption of normality was not met for all of the measures, it was expected that the violation of this assumption would not cause any major problems: Most of the parametric techniques are reasonably tolerant of violations of this assumption with large sample sizes (e.g., with $N > 200$; Gravetter & Wallnau, 2004).

Table 2. Descriptive statistics.

	N	Skewness		Kurtosis	
	Statistic	Statistic	Std. Error	Statistic	Std. Error
Pretest Productive Vocabulary	534	.73	.11	.18	.21
Pretest Narrative Skills	534	−.19	.11	−.12	.21
Pretest Listening Comprehension	534	−.68	.11	1.20	.21
Posttest Productive Vocabulary	534	.39	.11	−.248	.21
Posttest Narrative Skills	534	−.27	.11	.17	.21
Posttest Listening Comprehension	534	−.98	.11	1.20	.21
Story Comprehension	534	−.51	.11	−.26	.21

Multilevel Models

Students' posttest scores for story comprehension (level 1, $N = 534$) were nested within classes (level 2, $N = 23$). Scores on the other dependent variables (productive vocabulary, narrative skills, and listening comprehension; level 1, $N = 1068$) were measured before and after the intervention, and hence, were nested within students (level 2, $N = 534$) and classes (level 3, $N = 23$). In order to correct for the hierarchical structure of the data, multilevel modeling was applied using linear mixed model analyses with maximum likelihood (ML) estimations following the procedures of Snijders and Bosker (2004). For each dependent variable separate multilevel models were applied in which parameters were added systematically. To facilitate interpretation of the results, we have used standardized scores. Models were compared using the log likelihood ratio tests for model improvement (alpha of 0.05) and effect sizes were calculated using the procedures suggested by Tymms (2004).

For story comprehension, we compared the fit of four different models. Model 1 was the basic null (or intercept only) model which only accounted for random variance of students within classes (S^2_e) and random variance of classes (S^2_c). Two control variables were subsequently added as fixed effects: age (Model 2), and gender (Model 3). Age was added as a control variable as previous studies have shown that children's language competence develop quickly when they start attending early childhood classrooms (for example, Nærland, 2011; Tuijl & Leseman, 2007). Sex was added as a control variable, because it has been shown that girls generally outperform boys in language tests at a young age, although these sex differences seem to disappear during early childhood (Bornstein et al., 2004; Wallentin, 2008). In Model 4, condition was added as a fixed effect to test whether children between conditions differed in their scores on story comprehension.

For the other dependent variables (i.e., productive vocabulary, narrative skills, and listening comprehension), we performed the following sequence of models. Model 1 was the basic null (or intercept only) model which only accounted for random error (S^2_e) and random effects of classes (S^2_c) and students (S^2_s). That is, scores were allowed to vary between children and between classes. In Model 2 time was included as a fixed factor in order to test whether average scores differed between pre- and posttest. In Model 3 it was tested whether variances within and between students differed between the two measurement occasions. Model 4 tested variances between the two measurement occasions at the class level. Two control variables were subsequently added as fixed effects: age (Model 5), and gender (Model 6). In Model 7, condition was added as a fixed effect to test whether children between conditions differed in their scores on the dependent variable. Finally, in Model 8, the differences between conditions with regard to the scores on the pre- and posttest were allowed to vary between students and classes.

Results

Story Comprehension

Table 3 shows the results of the fit and comparisons of the planned models for story comprehension, productive vocabulary, narrative skills, and listening comprehension. As can be seen, for story comprehension (posttest-only), model 3 (including the control variables age and gender) fitted the data best. There was no effect of condition on the scores for story comprehension (model 4 versus

Table 3. Fit and comparison of nested models for scores on story comprehension, productive vocabulary knowledge, narrative skills, and listening comprehension (N = 534).

					Comparison		
Story Comprehension	Model	N_{pars}	−2 Loglikelihood	Models	ΔX^2	Δdf	*p*
1	Basic null model	3	1472.47				
2	+ age	4	1373.89	2 vs 1	98.58	1	< .001
3	+ gender	5	1365.61	3 vs 2	8.28	1	< .001
4	+ condition	7	1363.38	4 vs 3	2.23	2	ns
					Comparison		
Productive vocabulary	Model	N_{pars}	−2 Loglikelihood	Models	ΔX^2	Δdf	*p*
1	Basic null model	4	2939.69				
2	+ time (fixed)	5	2661.49	2 vs 1	278.40	1	<.001
3	+ time (random at student level)	6	2346.37	3 vs 2	314.92	1	<.001
4	+ time (random at class level)	8	2275.19	4 vs 3	71.18	2	<.001
5	+ age	9	2107.53	5 vs 4	167.66	1	<.001
6	+ gender	10	2096.29	6 vs 5	11.24	1	<.001
7	+ condition	12	2088.63	7 vs 6	7.66	2	<.05
8	+ condition*time	16	2086.06	8 vs 7	2.57	4	ns
					Comparison		
Narrative Skills	Model	N_{pars}	−2 Loglikelihood	Models	ΔX^2	Δdf	*p*
1	Basic null model	4	2973.92				
2	+ time (fixed)	5	2957.78	2 vs 1	16.14	1	<001
3	+ time (random at student level)	6	2928.42	3 vs 2	29.36	1	<.001
4	+ time (random at class level)	8	2920.79	4 vs 3	7.63	2	<.05
5	+ age	9	2796.49	5 vs 4	124.30	1	<.001
6	+ gender	10	2796.38	6 vs 5	0.11	1	ns
7	+ condition	11	2790.53	7 vs 5	5.96	2	ns
8	+ condition*time	13	2787.30	8 vs 5	9.19	4	ns
					Comparison		
Listening Comprehension	Model	N_{pars}	−2 Loglikelihood	Models	ΔX^2	Δdf	*p*
1	Basic null model	4	2897.92				
2	+ time (fixed)	5	2856.29	2 vs 1	41.63	1	<.001
3	+ time (random at student level)	6	2673.34	3 vs 2	182.95	1	<.001
4	+ time (random at class level)	8	2665.13	4 vs 3	8.21	2	<.05
5	+ age	9	2582.14	5 vs 4	82.99	1	<.001
6	+ gender	10	2578.17	6 vs 5	3.97	1	<.05
7	+ condition	12	2577.40	7 vs 6	0.77	2	ns
8	+ condition*time	14	2574.42	8 vs 6	3.75	4	ns

model 3, $X^2(2) = 2.23$, p = ns), indicating that there were no differences in children' story comprehension scores between the three conditions. Children in the mind map condition did not significantly score higher on story comprehension compared to children in the interactive reading condition (i.e., comparison condition). Table 4 shows the parameter estimates of the third model. On average, girls scored lower compared to boys ($\beta = -0.23$, $SE = 0.08$, $t = -2.90$, $p = .001$), and scores increased with approximately half a standard deviation per year of age ($\beta = 0.56$, $SE = 0.07$, $t = 8.37$, $p < .001$). Even after controlling for age and gender there were large differences in scores for Story Comprehension between and within classes, with 7% of the variance due to classes and 93% of the variance due to students within classes.

Productive Vocabulary

For productive vocabulary, model 7 (including the control variables age and gender and the main effect of condition) fitted the data best. Parameter estimates of this final model are presented in Table 5. On

Table 4. Parameter estimates of final model for children's scores on story comprehension, (N = 534).

Fixed part	Parameter	*SE*	*df*	*t*	*p*
Intercept	−2.59	0.38	381.20	−6.82	<.001
Age	0.56	0.07	399.33	8.37	<.001
Gender [1 = girl]	−0.23	0.08	506.90	−2.90	<.001
Random part	S^2	*SE*			
Classes	0.06	0.03			
Students	0.78	0.05			

Table 5. Parameter estimates of final model for children's scores on productive vocabulary.

Final model					
Fixed part	Parameter	*SE*	*df*	*t*	*p*
Pretest	−3.03	0.25	189.07	−12.35	<.001
Posttest	−2.15	0.25	196.92	−8.53	<.001
Age	0.53	0.04	187.10	12.41	<.001
Gender [1 = girl]	−0.18	0.05	514.18	−3.31	.001
Interactive reading condition	0.21	0.07	20.17	2.93	.008
Focused attention condition	0.14	0.07	18.55	1.88	.08
Mind map (reference category)	0	0			
Random part	S^2_{pre}	*SE*	S^2_{post}	*SE*	
Classes	0.01	0.01	0.08	0.03	
Students	0.38	0.02	0.77	0.05	

average, students scored higher on the posttest compared to the pretest ($F(1, 22.56) = 124.23$, $p < .001$, $r = .60$). Furthermore, girls scored lower than boys ($\beta = -0.18$, $SE = 0.05$, $t = -3.31$, $p = .001$), and scores increased with half a standard deviation per year of age ($\beta = 0.53$, $SE = 0.04$, $t = 12.41$, $p < .001$). Adjusted for differences in age and gender, the mean pre- and posttest scores for productive vocabulary were respectively −.41 ($SE = 0.03$) and .46 ($SE = 0.03$), which was a significant difference (95% CI [0.71, 1.04]). In addition, children in the interactive reading condition scored significantly higher compared to children in the other conditions at both the pre and posttest ($\beta = 0.21$, $SE = 0.07$, $t = 2.93$, $p = .008$). There was, however, no interaction effect between condition and time (model 8 versus model 7, $X^2(4) = 2.57$, p = ns), indicating that students' increase in productive vocabulary did not significantly differ between conditions. The results also show a large variance in scores for students and classes between pre- and posttest (respectively, model 3 versus model 2, $X^2(1) = 314.29$, $p < .001$ and model 4 versus model 3, $X^2(2) = 71.18$, $p < .001$). This variance was higher at the posttest (0.77 and 0.08 for students and classes respectively) compared to the pretest (0.38 and 0.01, respectively), indicating that individual and class-level differences grew over time.

Narrative Skills

For narrative skills, model 5 (including the control variable age but not gender) fitted the data best. Table 6 shows the parameter estimates of the fifth model. Again, students' scores for narrative skills were higher at the posttest compared to the pretest ($F(2, 40.51) = 36.68$, $p < .001$, $r = .21$). Average scores increased with two-fifth of a standard deviation per year of age ($\beta = 0.40$, $SE = 0.05$, $t = 7.33$, $p < .001$). Adjusted for differences in age, the mean pre- and posttest scores for narrative skills were respectively −0.16 ($SE = 0.06$) and 0.16 ($SE = 0.07$), which was a significant difference (95% CI [0.17, 0.47]). Results showed no main effect of condition (model 7 versus model 5, $X^2(2) = 5.96$, p = ns), or an interaction effect of condition by time (model 8 versus model 5, $X^2(4) = 9.19$, p = ns). Besides, results indicated a large variance in narrative skills scores between students and classes. However, while class-level variance increased from 0.03 ($SE = 0.02$) at the pretest to 0.07 at the posttest ($SE = 0.03$), differences in scores between students within classes decreased from 0.95 ($SE = 0.06$) to 0.77 ($SE = 0.05$).

Table 6. Parameter estimates of final model for children's scores on narrative skills.

Final model					
Fixed part	Parameter	*SE*	*df*	*t*	*p*
Pretest	−2.23	0.29	342.55	−7.74	<.001
Posttest	−1.92	0.29	349.85	−6.59	<.001
Age	0.40	0.05	384.01	7.33	<.001
Random part	S^2_{pre}	*SE*	S^2_{post}	*SE*	
Classes	0.03	0.02	0.07	0.03	
Students	0.95	0.06	0.77	0.05	

Listening Comprehension

Finally, for listening comprehension, model 6 (including age and gender) fitted the data best. Parameter estimates of this final model are presented in Table 7. Students' scores for listening comprehension were higher on the posttest compared to the pretest ($F(2, 39.14) = 55.34$, $p < .001$, $r = .53$). Furthermore, average scores were higher for girls than for boys ($\beta = 0.14$, $SE = 0.07$, $t = 2.01$, $p = .045$) and increased with one-fifth of a standard deviation per year of age ($\beta = 0.20$, $SE = 0.06$, $t = 3.49$, $p = .001$). Adjusted for differences in age and gender, the mean pre- and posttest scores for listening comprehension were respectively −.29 ($SE = 0.08$) and 0.30 ($SE = 0.05$), which was a significant difference (95% CI [0.46, 0.71]). There was no main effect of condition (model 7 versus model 6, $X^2(2) = 0.77$, p = ns) or an interaction effect of condition by time (model 8 versus model 6, $X^2(4) = 3.75$, p = ns). The variance components showed that differences between classes and students within classes decreased over time, with a decrease in variance between classes from 0.09 ($SE = 0.04$) to 0.04 ($SE = 0.02$) and between students from 1.01 ($SE = 0.06$) to 0.64 ($SE = 0.04$).

Discussion

This study examined the added benefits of using mind maps during interactive book reading on children's language development during an eight-week intervention in early childhood classrooms. In the current study, we compared three approaches to interactive book reading: (1) interactive book reading (our comparison condition), (2) interactive book reading with focused attention, and (3) interactive book reading using mind maps. Even though we expected that adding mind maps in the context of interactive book reading would promote children's language development even more – given the combination of pictures and text and their representation of the story – we did not find this in our study. In other words, in the current study we could not confirm that mind mapping in the context of interactive book reading results in a multimedia effect (e.g., adding pictures to a text to improves learning) or dual coding (e.g., the combination of words and pictures results in deeper processing). Interestingly, our results showed that children's language scores on all posttests were significantly higher compared to children's scores on the pretests. In other words, all three approaches to interactive book reading supported children's productive vocabulary, narrative skills, and listening

Table 7. Parameter estimates of final model for children's scores on listening comprehension.

Final model					
Fixed part	Parameter	*SE*	*df*	*t*	*p*
Pretest	−1.55	0.33	375.24	−4.66	<.001
Posttest	−0.96	0.33	369.92	−2.94	.003
Age	0.20	0.06	382.61	3.49	.001
Gender	0.14	0.07	508.07	2.01	.045
Random part	S^2_{pre}	*SE*	S^2_{post}	*SE*	
Classes	0.09	0.04	0.04	0.02	
Students	1.01	0.06	0.64	0.04	

comprehension. Children in the interactive reading condition scored significantly higher on productive vocabulary – they did so on both the pre- and posttest – but they did not improve their vocabulary scores more compared to students in the other two conditions. Surprisingly, we did not find any interaction effect of condition by time, meaning that all three shared book reading approaches were equally effective in enhancing children's language development. Our findings seems to be in line with previous studies that have found positive effects of interactive book reading routines in early childhood classrooms on different aspects of children's language development (e.g., Lever & Sénéchal, 2011; Mol & Bus, 2011; Mol et al., 2008). Interestingly, we found that even a new and relatively complex approach, such as using a mind map as a means to graphically represent a picture book, contributes to children's language development.

Interactive Book Reading Is Beneficial for Children's Language Development

How do the results of this study add to the current body of literature on interactive book reading? First, to be able to test the effect of our intervention we chose to assess children's productive vocabulary of the words that they encountered in the two stories. While receptive vocabulary is easier to test (and therefore more commonly used), the downside is that children have the possibility of guessing the right answer so that it remains uncertain how many words children actually learned (Wasik et al., 2016). Furthermore, a meta-analysis has shown that interactive book reading sessions contribute more to children's productive than receptive vocabulary (Mol et al., 2009). The results of our study seem to confirm these findings: repeatedly reading and discussing a story book has led children to expand their productive vocabulary. We assessed this by testing children's productive vocabulary of the words they encountered in the books, which is recommended when one wants to test the actual effect of a book reading intervention (Wasik et al., 2016). We found a higher productive vocabulary score on the posttest compared to the pretest for all three conditions with a difference of almost one standard deviation.

Second, the children in our study also improved on the two standardized and frequently used language tests that were unrelated to the books that were used during the intervention, i.e., listening comprehension and narrative skills. Children in our study scored higher on both posttests compared to the pretests, with effect sizes being large (r = .53) for listening comprehension and intermediate (r = .21) for narrative skills. This indicates that all three interactive reading conditions supported children to (1) better understand short stories that were read to them; and (2) produce better and more coherent stories. Our results align with a meta-analysis that showed a correlation of .25 in oral language skills (including story comprehension) before and after an interactive reading intervention (Mol et al., 2009).

Great Variance between Children and between Classes

Finally, our results showed large differences between classes and children for all outcome variables. How can this be explained? One possible explanation might be that young children in general show large individual differences in their language development (see for example, Fenson et al., 1994; Hart & Risley, 1995). Besides, relatively large differences in language learning opportunities between early childhood classrooms are reported as well (Barnes & Dickinson, 2017; Pelatti et al., 2014; Sun et al., 2020). These differences between classrooms can, for example, be found in the language that teachers use during their interactions with children. A study on teacher talk in interactive book reading sessions with young children showed that especially medium-level comments, such as word elaboration, story recall, and text-to-world connection promoted children's language and vocabulary development, whereas higher-level comments, such as inferencing and predicting, were less effective as they might have been too challenging (Sun et al., 2020). Perhaps the experimental conditions in our study (focused attention and mind map) were too challenging for at least some of the children in our sample. This might especially be the case for children with lower language levels (Barnes & Dickinson, 2017).

Furthermore, classroom factors, such as number of children in a classroom, proportion of at-risk children, and teacher turnover, all have been found to be negatively related to children's language and vocabulary development (Barnes & Dickinson, 2017). It is thought that in these classrooms teachers probably need to spend more time on classroom management, so that there is less time for interaction about the books. In our study, we did not control for these factors.

Finally, teachers in the mind map condition had to implement a complex routine in a relatively short period. This might have led to adjustment problems, such as the difficulty to maintain high quality teacher-child interactions whilst at the same time producing a mind map, which was also given as feedback to our research assistants. This might indicate that the teachers in our study needed more time for professional development to get acquainted with the mind map approach and to be able to use it properly during their interactive book reading sessions. The differences between classes that we found in our study suggest that the role of the teacher might be crucial when implementing a new interactive book reading approach.

Limitations

Our study has some limitations that need to be addressed. First, we had a wide variety of children and schools participating in our study, but unfortunately not all parents completed the questionnaire with background information about their child. As a consequence, we had missing values for some of our control variables (such as language background for 29.4% of our sample) which should be considered when interpreting the results. Second, teachers were trained to follow the reading intervention protocol related to the condition they were assigned to, but only some were filmed or observed during the execution of the intervention. Therefore, we cannot be certain that the reading intervention protocol was followed by all teachers. In future studies, given the large differences between classrooms, (video)observations are highly recommended to be able to guarantee treatment fidelity. This is supported by a previous meta-analysis, in which the authors showed that shared book reading interventions that were highly controlled had the highest effect sizes (Mol et al., 2009). Third, we designed our study to compare an interactive book reading routine using mind maps to two other interactive reading routines, because we were interested in the added benefits of using mind maps. Although the approach used in the interactive book reading condition is the default in most Dutch early childhood classrooms, and was therefore considered the comparison condition, we did not compare our mind map approach with repeated book reading without interaction or to another control group with a no-language-promoting intervention (Noble et al., 2019). Therefore, the results of our study should be interpreted carefully, as we cannot make any assertions about the language gains that children in this study have made compared to children in classrooms where no interactive book reading takes place.

Conclusions and Implications

Our study emphasizes the importance of interactive book reading for early childhood classrooms. All three interactive reading interventions improved children's productive vocabulary, narrative productive and listening comprehension skills. While the vocabulary test in our study was an example of "near transfer", as we tested the words and expression used in the book, children were also able to transfer their knowledge and skills to two standardized tests that were unrelated to the books that were read (i.e., "far transfer"). Children showed improvement on their ability to tell a story and to understand short stories, both of which are important aspects of children's cognitive development.

The results of this study are also relevant for educational practice. Even though our study did not show any effects of one of the interactive reading conditions over the other, we did find that children in all three conditions improved various aspects of their language skills in only a short period of eight weeks. This is an important finding, as many teachers in early childhood classrooms have incorporated interactive

reading into their early childhood classroom practices. In addition, the results of our study indicate that it might be worthwhile to explore variations on the traditional interactive reading practices, such as the use of mind maps. Furthermore, as mind maps are not common practice in early childhood education and the first results are promising, it might be worthwhile to develop and evaluate a more extensive professional development program to familiarize more teachers with this approach.

In sum, our study shows that engaging children in different forms of interactive book reading in early childhood classrooms is highly recommended, which is in line with previous meta-analyses (e.g., Flack, Field, & Horst, 2018; Mol et al., 2009). Results of our study show that engaging children in an interactive reading session only once a week in a normal whole-group situation in a regular early childhood classroom situation is related to improved language skills, such as vocabulary, narrative skills, and listening comprehension.

Disclosure Statement

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

Funding

This work was supported by the Netherlands Initiative for Education Research (NRO) [grant number 405-16-506].

ORCID

Menno van der Schoot http://orcid.org/0000-0002-4762-2718
Chiel van der Veen http://orcid.org/0000-0002-7517-4764

References

Abi-El-Mona, I., & Adb-El-Khalick, F. (2008). The influence of mind mapping on eight graders' science achievement. *School Science and Mathematics*, *108*(7), 298–312. https://doi.org/10.1111/j.1949-8594.2008.tb17843.x

Adan-Dirks, R. (2012). Assessing vocabulary development. In B. Van Oers (Ed.), *Developmental education for young children: Concept practice and implementation* (pp. 87–104). Springer.

Barnes, E. M., & Dickinson, D. K. (2017). The relationship of head start teachers' academic language use and children's receptive vocabulary. *Early Education and Development*, *28*(7), 794–809. https://doi.org/10.1080/10409289.2017.1340069

Bornstein, M. H., Hahn, C. S., & Haynes, O. M. (2004). Specific and general language performance across early childhood: Stability and gender considerations. *First Language*, *24*(3), 267–305. https://doi.org/10.1177/0142723704045681

Bracken, S. S., & Fischel, J. E. (2008). Family reading behavior and early literacy skills in preschool children from low-income backgrounds. *Early Education and Development*, *19*(1), 45–67. https://doi.org/10.1080/10409280701838835

Budd, J. W. (2004). Mind maps as classroom exercises. *The Journal of Economic Education*, *35*(1), 35–46. https://doi.org/10.3200/JECE.35.1.35-46

Buzan, T. (2005). *The ultimate book of mind maps*. Thorsons.

De Temple, J., & Snow, C. E. (2003). Learning words from books. In A. Van Kleeck, S. A. Stahl, & E. B. Bauer (Eds.), *On reading books to children: Parents and teachers* (pp. 15–34). Lawrence Erlbaum Associates, Inc.

Dickinson, D. K., & Porche, M. V. (2011). Relation between language experiences in preschool classrooms and children's kindergarten and fourth-grade language and reading abilities. *Child Development*, *82*(3), 870–886. https://doi.org/10.1111/j.1467-8624.2011.01576.x

Duursma, E., Augustyn, M., & Zuckerman, B. (2008). Reading aloud to children: The evidence. *Archives of Disease in Childhood*, *93*(7), 554–557. http://dx.doi.org/10.1136/adc.2006.106336

Eitel, A., & Scheiter, K. (2015). Picture or text first? Explaining sequence effects when learning with pictures and text. *Educational Psychological Review*, *27*(1), 153–180. https://doi.org/10.1007/s10648-014-9264-4

Farrand, P., Hussain, F., & Hennessy, E. (2002). The efficacy of the 'mind map' study technique. *Medical Education*, *36*(5), 426–431. https://doi.org/10.1046/j.1365-2923.2002.01205.x

Fenson, L., Dale, P. S., Reznick, J. S., Bates, E., Thal, D. J., & Pethick, S. J. (1994). Variability in early communicative development. *Monographs of the Society for Research in Child Development*, *59*(5), i+iii–v+1-185. https://doi.org/10.2307/1166093

Flack, Z. M., Field, A. P., & Horst, J. S. (2018). The effects of shared storybook reading on word learning: A meta-analysis. *Developmental Psychology*, *54*(7), 1334–1346. http://10.1037/dev0000512

Ghonem-Woets, K. (2009). *Elke dag boekendag. Verslag van een onderzoek naar het voorlezen van prentenboeken in groep 1 en 2*. [Every day book day. Research report on picture book reading in kindergarten]. Stichting Lezen.

Gonzalez, J. E., Pollard-Durodola, S., Simmons, D. C., Taylor, A. B., Davis, M. J., Fogarty, M., & Simmons, L. (2014). Enhancing preschool children's vocabulary: Effects of teacher talk before, during and after shared reading. *Early Childhood Research Quarterly*, *29*(2), 214–226. https://doi.org/10.1016/j.ecresq.2013.11.001

Gravetter, F. J., & Wallnau, L. B. (2004). *Statistics for the behavioral sciences*. Wadsworth.

Hart, B., & Risley, T. R. (1995). *Meaningful differences in the everyday experience of young American children*. Paul H Brookes Publishing.

Lansink, N. (2009). *LOVS Taal voor kleuters groep 1 en 2* [Student monitoring system language for preschoolers]. Cito.

Leathers, P. (2015). *Het zwarte konijn*. [The black rabbit]. Lemniscaat.

Lepola, J., Lynch, J., Laakkonen, E., Silvén, M., & Niemi, P. (2012). The role of inference making and other language skills in the development of narrative listening comprehension in 4-6-year-old children. *Reading Research Quarterly*, *47*(3), 259–282. https://doi.org/10.1002/rrq.020

Lever, R., & Sénéchal, M. (2011). Discussing stories: On how a dialogic reading intervention improves kindergartners' oral narrative construction. *Journal of Experimental Child Psychology*, *108*(1), 1–24. https://doi.org/10.1016/j.jecp.2010.07.002

Levie, W. H., & Lentz, R. (1982). Effects of text illustrations: A review of research. *Educational Technology Research and Development*, *30*(4), 195–232. https://doi.org/10.1007/BF02765184

Mayer, R. E. (2002). Multimedia learning. *Psychology of Learning and Motivation: Advances in Research and Theory*, *41*, 85–139. https://doi.org/10.1016/S0079-7421(02)80005-6

Merchie, E., & Van Keer, H. (2013). Schematizing and processing informational texts with mind maps in fifth and sixth grade. *Middle Grades Research Journal*, *8*(3), 61–81.

Merchie, E., & Van Keer, H. (2016a). Stimulating graphical summarization in late elementary education: The relationship between two instructional mind-map approaches and student characteristics. *The Elementary School Journal*, *116*(3), 487–522. https://doi.org/10.1086/684939

Merchie, E., & Van Keer, H. (2016b). Mind mapping as a meta-learning strategy: Stimulating pre-adolescents' text-learning strategies and performance? *Contemporary Educational Psychology*, *46*, 128–147. https://doi.org/10.1016/j.cedpsych.2016.05.005

Mol, S. E., & Bus, A. G. (2011). To read or not to read: A meta-analysis of print exposure from infancy to early adulthood. *Psychological Bulletin*, *137*(2), 267–296. https://doi.org/10.1037/a0021890

Mol, S. E., Bus, A. G., & De Jong, M. T. (2009). Interactive book reading in early education: A tool to stimulate print knowledge as well as oral language. *Review of Educational Research*, *79*(2), 979–1007. https://doi.org/10.3102/0034654309332561

Mol, S. E., Bus, A. G., De Jong, M. T., & Smeets, D. J. H. (2008). Added value of dialogic parent–child book readings: A meta-analysis. *Early Education and Development*, *19*(1), 7–26. https://doi.org/10.1080/10409280701838603

Nærland, T. (2011). Language competence and social focus among preschool children. *Early Child Development and Care*, *181*(5), 599–612. https://doi.org/10.1080/03004431003665780

National Center for Family Literacy. (2008). *Developing early literacy: Report of the National Early Literacy Panel: A scientific synthesis of early literacy development and implications for intervention*. National Institute for Literacy.

NICHD Early Child Care Research Network. (2005). Pathways to reading: The role of oral language in the transition to reading. *Developmental Psychology*, *41*(2), 428–442. https://doi.org/10.1037/0012-1649.41.2.428

Noble, C., Sala, G., Peter, M., Lingwood, J., Rowland, C., Gobet, F., & Pine, J. (2019). The impact of shared book reading on children's language skills: A meta-analysis. *Educational Research Review*, *28*, 100290. https://doi.org/10.1016/j.edurev.2019.100290

Paivio, A. (2006). *Dual coding theory and education*. Draft chapter for the conference on "Pathways to Literacy Achievement for High Poverty Children", The University of Michigan School of Education. https://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.329.7319&rep=rep1&type=pdf

Pelatti, C. Y., Piasta, S. B., Justice, L. M., & O'Connell, A. (2014). Language- and literacy-learning opportunities in early childhood classrooms: Children's typical experiences and within-classroom variability. *Early Childhood Research Quarterly*, *29*(4), 445–456. https://doi.org/10.1016/j.ecresq.2014.05.004

Schafer, J. L., & Graham, J. W. (2002). Missing data: Our view of the state of the art. *Psychological Methods*, *7*(2), 147–177. https://doi.org/10.1037//1082-989X.7.2.147

Schnotz, W. (2002). Commentary: Towards an integrated view of learning from text and visual displays. *Educational Psychology Review*, *14*(1), 101–120. https://doi.org/10.1023/A:1013136727916

Sénéchal, M. (2006). Testing the home literacy model: Parent involvement in kindergarten is differentially related to Grade 4 reading comprehension, fluency, spelling, and reading for pleasure. *Scientific Studies of Reading*, *10*(1), 59–87. https://doi.org/10.1207/s1532799xssr1001_4

Sénéchal, M., & LeFevre, J. (2002). Parental involvement in the development of children's reading skill: A 5-year longitudinal study. *Child Development*, *73*(2), 445–460. https://doi.org/10.1111/1467-8624.00417

Sénéchal, M., LeFevre, J., Thomas, E., & Daley, K. (1998). Differential effects of home literacy experiences on the development of oral and written language. *Reading Research Quarterly*, *32*(1), 96–116. https://doi.org/10.1598/rrq.33.1.5

Snijders, T. A. B., & Bosker, R. J. (2004). *Multilevel analysis: An introduction to basic and advanced multilevel modelling*. Sage.

Sun, H., Toh, W. M., & Steinkrauss, R. (2020). Instructional strategies and linguistic features of kindergarten teachers' shared book reading: The case of Singapore. *Applied Psycholinguistics*, *41*(2), 427–456. https://doi.org/10.1017/S0142716420000053

Tuijl, C., & Leseman, P. M. (2007). Increases in the verbal and fluid cognitive abilities of disadvantaged children attending preschool in the Netherlands. *Early Childhood Research Quarterly*, *22*(2), 188–203. https://doi.org/10.1016/j.ecresq.2007.02.002

Tymms, P. (2004). Effect sizes in multilevel models. In I. Schagen, & K. (Eds.), *But what does it mean? Calculating effect sizes in educational research* (pp. 55–66). National Foundation for Educational Research.

Van Der Veen, C., Dobber, M., & Van Oers, B. (2016). Implementing dynamic assessment of vocabulary development as a trialogical process: A practice of teacher support in primary school education schools. *Language Assessment Quarterly*, *13*(4), 329–340. https://doi.org/10.1080/15434303.2016.1235577

Van Kleeck, A. (2008). Providing preschool foundations for later reading comprehension: The importance of and ideas for targeting inferencing in storybook-sharing interventions. *Psychology in the Schools*, *45*(7), 627–643. https://doi.org/10.1002/pits.20314

Verhoeven, L., & Vermeer, A. (2006). *Verantwoording Taaltoets Alle Kinderen (TAK)*. [Justification language test for all children]. Cito.

Visser, R., & Meirink, T. (2017). *De wedstrijd van schildpad en haas*. [The competition of tortoise and hare]. Book2download.

Wallentin, M. (2008). Putative sex differences in verbal abilities and language cortex: A critical review. *Brain & Language*, *108*(3), 175–183. https://doi.org/10.1016/j.bandl.2008.07.001

Wasik, B. A., & Bond, M. A. (2001). Beyond the pages of a book: Interactive book reading and language development in preschool classrooms. *Journal of Educational Psychology*, *93*(2), 243–250. https://doi.org/10.1037//0022-0663.93.2.243

Wasik, B. A., Hindman, A. H., & Snell, E. K. (2016). Book reading and vocabulary development: A systematic review. *Early Childhood Research Quarterly*, *37*, 39–57. https://doi.org/10.1016/j.ecresq.2016.04.003

Whitehurst, G. J., Falco, F. L., Lonigan, C. J., Fischel, J. E., DeBaryshe, B. D., Valdez-Menchaca, M. C., & Caulfield, M. (1988). Accelerating language development through picture book reading. *Developmental Psychology*, *24*(4), 552–559. https://doi.org/10.1037/0012-1649.24.4.552

Zevenbergen, A. A., Whitehurst, G. J., & Zevenbergen, J. A. (2003). Effects of a shared-reading intervention on the inclusion of evaluative devices in narratives of children from low-income families. *Journal of Applied Developmental Psychology*, *24*(1), 1–15. https://doi.org/10.1016/S0193-3973(03)00021-2

Zucker, T. A., Cabell, S. Q., Justice, L. M., Pentimonti, J. M., & Kaderavek, J. N. (2012). The role of frequent, interactive prekindergarten shared reading in the longitudinal development of language and literacy skills. *Developmental Psychology*, *49*(8), 1425–1439. https://doi.org/10.1037/a0030347

Appendix A.

Main characteristics of the three different book reading conditions

	Interactive Book Reading	Book reading with focused attention	Book reading with mind mapping
Session 1	Interactive reading with focus on prediction	Reading with specific question: who is this story about?	Reading with specific question and constructing "who-branch"
Session 2	Interactive reading with focus on comprehension	Reading with specific question: where takes the story place?	Reading with specific question and constructing "where-branch"
Session 3	Interactive reading with focus on feelings	Reading with specific questions: what are the main problems and how are they solved?	Reading with specific questions and constructing "problem-branch" and "solution-branch"
Session 4	Story table	Story table	Story table

Appendix B

Short synopsis of the books that were read during the intervention

"The Black Rabbit" is a children's book about a Rabbit who is confronted with a large rabbit chasing him: Black Rabbit. Rabbit is afraid of Black Rabbit and tries to get rid of him, but Black Rabbit keeps following him wherever Rabbit goes. Who is this mysterious Black Rabbit? And why won't he go away? Only from the pictures it finally becomes clear that Black Rabbit is actually Rabbit's own shadow.

"The Competition of Tortoise and Hare" is a retelling of one of Aesop's fables. In this book the animals are doing a running competition. The Hare is confident of winning, so he is adding extra jumps to his race, while the Tortoise is moving slowly, but steadily . . . Finally, the Hare gets overconfident and he injures himself. The Tortoise wins the competition.

Appendix C.

Five questions to measure story comprehension

The Black Rabbit	1	Why is Rabbit always being chased by Black Rabbit? (Why is the Black Rabbit always after Rabbit?)
	2	Where was the Black Rabbit when Rabbit was in the dark forest? (Does Rabbit still see the Black Rabbit in the dark forest?)
	3	Why doesn't Wolf eat Rabbit?
The Competition of Tortoise and Hare	4	Do you remember the begin of the story? Who did you think would win the competition? Why did you think that?
	5	How come Tortoise won the competition?