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Associations between students' reading performance and literacy instruction in first grade: a cross-lagged study

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Abstract

This cross-lagged study examined the classroom-level associations between the reading performance of first-grade students ($N=537$) and observed literacy instruction activities in classrooms ($N=30$) in the autumn and spring terms. The multilevel analyses indicated that lower average word reading skills in the classrooms (i.e., there were more students who were learning to read) in the autumn were associated with higher amount of activities supporting consolidation of reading and spelling skills in the spring. In contrast, higher average word reading skills in the classrooms in the autumn were associated with higher amount of independent meaning-focused activities in the spring. Higher extent of whole-group meaning-focused activities in the autumn was positively associated with reading comprehension at classroom level in the spring, whereas independent phonological recoding practice in the autumn was negatively associated with reading comprehension in the spring. The study provides novel understanding of the associations between students' reading performance and literacy instruction especially showing how students' reading skills at classroom level may inform instruction in the classroom. This information may guide teachers to adapt their instruction at classroom level but also to identify the students needing differentiation. The results also acknowledge the affordances and limitations students' skills may set for the instruction.

Keywords Literacy instruction · Adapting instruction · Word reading · Reading comprehension · First grade

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To identify the best practices for support students' reading skills development, it is critical to address how teachers' practices should change in accordance with their students' development (Connor & Morrison, 2016; Juel & Minden-Cupp, 2000; Pressley et al., 2001). Although balanced instructional support in both word reading and reading comprehension is reportedly beneficial to students (Connor et al., 2013; Pressley et al., 2001), studies focusing on single forms of literacy instruction content dominate the literature (e.g., Baker et al., 2020; Rasinski et al., 2020; Schwanenflugel et al., 2009). Importantly, studies that examined how students' individual characteristics impact on what kind of instruction is most beneficial for them (Connor et al., 2013; Connor & Morrison, 2016; Foorman et al., 1998) as well as instructional adaptations during instruction (for a review, see Parsons et al., 2018) have increased our understanding of the multifaceted interplay between instructional activities and student learning. However, more research is needed to clarify how students' evolving skills interact with instruction at the classroom level during the school year.

The rich interactions in the whole classroom cannot fully be captured by assessing the instructional interactions between a teacher and few focal students. As teachers adapt their instruction to the varying skills of their students, their selected literacy content and mode of instruction are likely to differ between a classroom with many beginning readers and one in which most students can decode words or read fluently (Ruotsalainen et al., 2022a, 2022b). The reading skills among the students in a classroom may, thus, both set limitations on and provide affordances to meeting individual student's needs during lessons. By applying cross-lagged multilevel modelling to data collected in the autumn and spring of the first school year, the present study explored the classroom-level associations between Finnish students' reading performance and literacy instruction with respect to both the activities' content (code-focused vs. meaning-focused) and management (teacher/child-managed vs. child-managed) in authentic classrooms.

Associations between instruction and emerging reading skill development

The Simple View of Reading (SVR; Gough & Tunmer, 1986) outlines the basic components underlying efficient reading with a focus on comprehension: skills related to word reading and linguistic comprehension. Research has shown that linguistic comprehension contributes a unique variance to reading comprehension across grades (e.g., de Jong & van der Leij, 2002; Florit & Cain, 2011; Torppa et al., 2016). In contrast, the effect of word reading skills (accuracy and fluency) on reading comprehension is typically seen during the first year or first few years of reading acquisition, depending on the depth of the orthography (Florit & Cain, 2011).

Notably, the literature has demonstrated that both beginning readers and students who struggle to master decoding skills benefit from explicit instruction on the phonological recoding of words (e.g., Al Otaiba et al., 2023; Connor et al., 2004, 2013; Lovett et al., 2017; Sunde et al., 2019) and support for reading fluency (Rasinski et al., 2020; Ruotsalainen et al., 2022b). However, practicing phonological recoding after achieving mastery does not appear to support further reading skill development (Connor et al., 2004; Lerkkanen et al., 2016; Sunde et al., 2019). The wide variation in students' skills may influence on the weaker association between observed classroom practices and word reading skills at

classroom-level (Cao et al., 2022) compared to the findings from intervention studies for students with reading difficulties (Al Otaiba et al., 2023).

While comprehension skills develop via exposure to language and texts across an individual's life (Paris, 2005), they, too, should be addressed during instruction to improve learning outcomes. Providing support for comprehension skills helps the students in interpreting texts and attaching meanings to them (Baker et al., 2020; Connor & Morrison, 2016). Compared to word reading skills, studies have shown stronger associations between observed classroom practices and classroom-level reading outcomes when the outcome measure has included a mixture of reading skills including reading comprehension (Cao et al., 2022), while interventions on reading comprehension skills for poor readers are shown to be less effective (Al Otaiba et al., 2023). Lerkkanen et al. (2016), for example, showed that teaching characterised with support for content understanding via conversations and peer cooperation is beneficial to all students despite the initial reading skills of the first graders. This is reflected also in a study by Connor et al. (2020), in which the association between teacher talk and reading comprehension was mediated via student talk. That is, the more the teacher engaged students into discussions, the more the students talked themselves, and the better their reading comprehension results were at the classroom level.

Reportedly, a shift in the emphasis of literacy instruction from practicing word-level reading to text-level reading and comprehension in line with students' reading skills can bolster the progress of beginning readers (Connor et al., 2004; Juel & Minden-Cupp, 2000; Pressley et al., 2001). Comprehension skills are reinforced in the classroom with listening comprehension and vocabulary practice, which also contribute to skills vital to reading comprehension before students can read by themselves (Baker et al., 2020; Connor et al., 2004; Lepola et al., 2016; Lerkkanen et al., 2004). In addition to their diverse content needs, students also require different amounts of instructional support to learn (e.g., Corno, 2008; Ponitz & Rimm-Kaufman, 2011; Pressley et al., 2001; Van de Pol et al., 2010). Following Connor et al. (2004), students with weaker vocabularies and/or word reading skills benefit from teacher-managed focus of attention to improve both their phonological recoding and comprehension skills, whereas students with more advanced vocabularies and decoding skills benefit to a greater extent from independently practicing reading- and writing-related tasks.

Research has shown that instruction that is adapted to students' prior skills is more beneficial for their skill development (Parsons et al., 2018). It is well acknowledged that students' skills also affect instruction (Jaeger, 2016), and that those teachers, who take this information into account, are generally considered more effective (Parsons et al., 2018; Pressley et al., 2001). This understanding implies a need to address bidirectional relationship between instruction and students' skills. Yet, empirical evidence on this bidirectional relationship is scarce, as much of the research has focused on unidirectional associations between literacy instruction and students' skills (Connor et al., 2004), on the one hand, and on teachers' responses to an individual student's needs (Nurmi et al., 2013) or instructional adaptations during learning situations (Vaughn, 2019) on the other hand. Studies examining the bidirectional associations between students' skills and literacy instruction are rare especially at classroom level (as an exception, see Carlisle et al., 2011). These examinations would be highly important for providing insights in planning the instruction to meet students' learning needs.

Two studies have explicitly examined the associations between students' entry-level skills and instruction at classroom level: Carlisle et al. (2011) examined the associations between student characteristics and instruction on reading comprehension in third grade,

and Ruotsalainen et al., (2022a, 2022b) investigated the associations between students' word reading skills and literacy instruction activities in first grade autumn. Despite different reading skills and grades examined in the studies, lower entering skills were associated with teacher-led instruction while higher entering skills were associated with activities including more independent work. However, both studies addressed only one type of reading skill (namely either word reading skills or reading comprehension), and neither of these studies looked at the associations between students' reading skills and instruction specifically across first grade.

Prior studies of Connor et al. (2004), Juel and Minden-Cupp (2000), and Pressley et al. (2001) have provided some information on the changes in literacy content across the first grade, but they did not explore statistically how changes in instructional contents were associated with the students' skill development or the potential effects of the students' reading skills in classrooms on instruction. Students' skills at classroom level may set the pace for instruction that is likely to be more beneficial to some students, while some of the students require more individualised instruction (Corno, 2008).

It should be noted, however, that the vast majority of the studies examining the associations between observed instructional practices and reading skills have been conducted in the USA (for a meta-analysis, see Cao et al., 2022). More research is needed from educational contexts other than that of the USA to validate existing understanding of the associations between literacy instruction and reading skills.

Reading skill development and literacy instruction in Finland

Following the national core curriculum (Finnish National Agency for Education, 2016), formal literacy instruction in Finland begins in the first grade when children are 7 years of age. Seven lessons per week are devoted to literacy instruction in the first grade. At school entry, more than half of first graders (Ukkola & Metsämuuronen, 2019) can decode at least simple single words, and nearly all students achieve high decoding accuracy after a few months of formal reading instruction (Lerkkanen et al., 2004) and become fluent readers by the end of their first school year (Soodla et al., 2015). Nearly all children attend their nearest public school (Linnakylä et al., 2007), and the differences between schools and classrooms are small (Ukkola & Metsämuuronen, 2019).

Finnish primary school teachers have a Master of Education degree, and they possess high autonomy in planning and implementing their instructional practices. Significantly, they are expected to carefully monitor their students' skills and adapt their instruction accordingly.

Aim of the study

The present study aims to fill in the existing gaps in the literature by examining the bidirectional associations between literacy instruction and reading skills at classroom level. The meta-analysis by Cao et al. (2022) showed that during the early grades, the focus has typically been on the associations between observed classroom practices and word reading skills and to a lesser extent between observed classroom practices and reading comprehension. Thus, both word reading skills and reading comprehension are included in the present study. The instructional activities were video-recorded during the autumn and spring terms

and coded in line with the adapted observation system by Connor et al. (2010), targeting both content and management of the instruction at the classroom level. Research questions and hypotheses (H1–H3) were set as follows:

1. Are students' word reading skills in the autumn associated with the amount of time spent in different literacy instruction activities in the spring? Although there is a scarcity of knowledge of whether and how students' reading skills are associated with literacy instruction activities, it could be hypothesised, that higher reading skills in the classroom at school entry are associated with higher amount of activities focusing on understanding on the texts and independent work (H1), whereas lower entry-level skills are associated with higher amount of teacher-led activities focusing on code-related skills (H2) (Carlisle et al., 2011; Lerkkanen et al., 2016; Ruotsalainen et al., 2022a, 2022b).
2. Is the amount of time spent in different literacy instruction activities in the autumn associated with students' word reading skills and reading comprehension in the spring? We expect to find positive associations between observed literacy instruction activities and the skills they are targeted to support (H3) (Connor & Morrison, 2016).

Methods

Participants and procedure

The data for the present study were drawn from a longitudinal study conducted in Central Finland (Lerkkanen & Pakarinen, 2016). Beforehand, the university's ethical committee granted ethical approval for the study. In addition, the teachers gave their written consent to take part in the study, and the guardians gave their written consent for their children's participation. The data comprised one video-recorded literacy lesson in the autumn term (T1) and one video-recorded literacy lesson in the spring term (T2) of 30 classrooms and skill assessments of 537 first-grade students (51.8% boys; $M=7.20$ years, $SD=0.31$ years for the beginning of first grade) in these classrooms. The mean class size in the sample was 17.83 ($SD=3.55$). The lesson length varied from 28 to 80 min ($M=41.55$, $SD=10.73$) at T1 and from 22 to 76 min at T2 ($M=37.32$, $SD=9.43$).

Video recordings of the literacy lessons and skill assessments of the students were carried out during the autumn (between September and December) and spring (between February and May) terms such that both were completed within a two- to 3-week period for each term (autumn: $M=15.55$ days, $SD=12.84$ days; spring $M=11.40$ days, $SD=10.39$ days). T1 and T2 assessments were approximately 5 months ($SD=0.52$ months, range 4.14–6.21 months) apart in each classroom.

Questionnaire data included information on the teachers' education levels and work experience as well as the mothers' education levels. All but one of the teachers (29 out of 30) were female, and all teachers had a master's degree in education. Teaching experience ranged from 6 months to 39 years ($M=16.20$ years, $SD=9.69$ years). Of the mothers, 3% had only completed the compulsory 9-year education, 35% had only completed secondary education, 33% had either a bachelor's degree or a vocational college degree as their highest degree and 29% had completed a master's degree or higher. The mothers' education levels were somewhat higher than those of the general population of Central Finland (Official Statistics of Finland, 2018), which ranged from 8%, 47%, 24% to 21%, respectively.

Information on parental education was missing for 39.7% of the families participating in this study.

Measures

Word reading skills

Students' reading accuracy and reading fluency were assessed individually at T1 and T2, and a composite of their word reading skills was calculated for both time points. The *reading accuracy* test (Lerkkanen et al., 2006) comprised a 20-item word list of two- to five-syllable words. The test was discontinued if the students did not provide a response or gave an incorrect response to three consecutive test items. The students were awarded one point for each correctly read word (maximum 20 points). The students' *reading fluency* was assessed with a reading fluency test (Häyrynen et al., 1999) during which they read aloud from a word list (maximum of 90 words) within a 45-s time limit. The students were awarded one point for each correctly read word (maximum score of 90 points).

A composite score (i.e., mean) for reading accuracy and fluency was calculated based on the standardised test scores with equal weight for the analyses. The Cronbach's alpha for the composite word reading skill was 0.84 at T1 and 0.62 at T2. The lower reliability at T2 likely occurred because of a possible ceiling effect for reading accuracy in the spring. The test-retest reliability for the composite word reading skill measure was 0.70.

Reading comprehension

The students' reading comprehension skills were assessed using a group-administered, nationally normed reading comprehension test (ALLU; Lindeman, 1998) at T2. The students were asked to read a page-long expository text and answer 12 questions. Eleven of the questions were multiple choice, and one question required the students to organise the information in the same order as in the text. The students were allotted approximately 30 min to complete the test, but they also had the option to continue the test during the 15-min recess after the lesson. Standardised test scores were used in the analyses. The Cronbach's alpha for reading comprehension was 0.83.

Coding the observed literacy instruction

The literacy instruction activities from the video recordings of the literacy lessons were coded following the guidelines of the Individualizing Student Instruction (ISI/Pathways) observation system (Connor et al., 2010) and its manual adapted to the Finnish context (Poikkeus et al., 2013). In the present study, the coding and analyses of the literacy instruction activities were made at the classroom level in contrast to the original ISI coding (see Connor et al., 2009, 2010), which focuses on content, management and context of instruction at the student level (i.e., from the viewpoint of what kind of instruction is received by the focus student). The present study assessed the two dimensions of management and content as well as their combinations. While coding, each activity that lasted at least 10 s was coded with respect to both the management and content of literacy instruction.

Management was coded with respect to who was responsible for directing the students' attention to the task: (1) the teacher and the students together (teacher/child-managed [TCM]) or (2) the student or the students together (child-managed [CM]). In addition, the

dimension of context was integrated into coding of management. TCM activities were observed during whole-group activities, whereas CM activities were observed during independent individual and small-group work. Significantly, even though most students managed their own attention (coded as CM) during individual and small-group work, the teachers were typically available to help the students and provided management support for one student or small group at a time.

Content was coded using a modified coding scheme in which language-specific features of Finnish were taken into account (Poikkeus et al., 2013). In line with the common division of literacy skills into components of decoding and comprehension (cf. simple view of reading framework; Gough & Tunmer, 1986), coding was divided into code-focused (CF) and meaning-focused (MF) activities (Connor & Morrison, 2016). CF activities refer to instructional content that seeks to support students' reading and writing acquisition with respect to achieving accuracy and fluency, and these contents typically focus on letter knowledge, phonological awareness, decoding, spelling and fluency activities. MF activities support students' comprehension skills, and they typically focus on listening and reading comprehension activities and activities that enhance vocabulary growth and grammatical knowledge. The Finnish adaptations involved subcodes for CF activities. For example, additions were made related to the use of syllables in early decoding and spelling instruction. Moreover, omissions were made regarding subcodes such as onset and rime, which are not used in the Finnish context. During the coding process, the durations of the different content categories, initially assessed at the detailed subcode level, were subsequently summed under the broader content categories of CF and MF activities.

To conduct the analyses, four combination categories of management and content were formed: TCM-CF and TCM-MF for whole-group instruction and CM-CF and CM-MF for independent individual, pair, and small-group work. Table 1 provides examples of the combination categories. Notably, not all combination categories were observed in each classroom at T1 and T2. Out of the 30 classrooms, TCM-CF activities were observed in 30 (T1) and 22 (T2) classrooms, TCM-MF in 24 (T1) and 30 (T2) classrooms, CM-CF in 27 (T1) and 17 (T2) classrooms and CM-MF in 7 (T1) and 22 (T2) classrooms, respectively.

Table 1 Examples of combination categories of management and content

Content	Management	
	Teacher/child-managed (TCM) ¹	Child-managed (CM) ²
Code-focused (CF)	The teacher shows a letter, and the students produce the sound that corresponds to the letter	The students practice letter forms independently
	The students read a word list aloud from the whiteboard	The students practice reading syllables/words independently
	Choral rereading of a text	The students reread a text a couple of times together
Meaning- focused (MF)	The meaning of a new concept is discussed in the classroom	A student silently reads a book after finishing the previous task early
	The teacher or student reads a text as others listen	The students write sentences independently or in groups
	The teacher asks the students to arrange pictures so that they represent the story plot that has just been read aloud	The students work on a reading comprehension task in a workbook based on the text that was previously discussed in the classroom

¹ Whole-group activities; ² Independent and small-group work activities

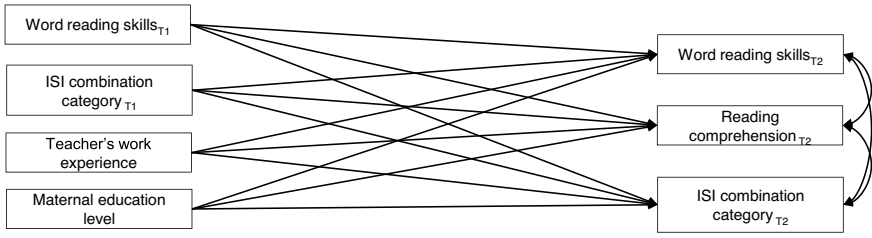
The analyses examined how the teachers divided their instructional time during literacy lessons using different activities. As the lesson length differed both between and within classrooms, the percentages of TCM-CF, TCM-MF, CM-CF, and CM-MF activities were calculated and used in the analyses. The percentages were calculated by dividing the total duration (in seconds) of each combination category by the total classroom instruction time. Instruction time was specified as the time between when the teacher started the lesson and when they finished it. The percentage for each combination category could range from 0% (not observed during the lesson) to 100% (all the activities fell into the given combination category). Intercooder reliability was determined for 20% of the lessons (six lessons both in autumn and spring), which were double coded. Intercooder reliability between the two coders, calculated as intraclass correlations (ICCs) of the durations (in seconds) of the combination categories, was 0.99 (95% CI=0.99, 1.00) at T1 and 0.97 (95% CI=0.93, 0.99) at T2.

Analyses

First, ICCs were examined regarding the students' word reading and reading comprehension skills and their mothers' education levels. The ICCs showed statistically significant differences between the classrooms in word reading skills at both T1 and T2 and the mothers' education levels. Belonging to a certain classroom explained 5% ($p=0.032$) of the students' word reading skills at T1 and 3% ($p=0.025$) at T2. Membership in a certain classroom accounted for 13% ($p=0.003$) of the variance in the mothers' education levels. The ICC for reading comprehension at T2 was marginally significant ($p=0.061$), explaining 7% of the variance.

Second, multilevel analyses were conducted with Mplus (version 7.3; Muthén & Muthén, 1998–2012). Multilevel modelling allows one to examine how much the variation is due to variation between classrooms (between level in Fig. 1) and how much of the variation is due to individual differences between students (within level in Fig. 1). The models were specified to examine the cross-lagged relations between the different literacy instruction activities (ISI combination categories) and students' reading skills at classroom level. This allows to control the previous level of both instructional activities and reading skills. The associations between instructional activities (TCM-CF, TCM-MF, CM-CF, and CM-MF) and reading performance were analysed in four separate models. In each of the models, at the between level, the outcome measures at T2 (instructional activity, word reading skills, reading comprehension) were regressed on the previous levels of the variables and on the teachers' work experience and the mothers' education levels. At the within level, the students' reading skills were regressed on previous level of word reading skills, gender, and mother's education level. Nonsignificant paths were set to zero for the sake of model parsimony due to rather low number of classrooms (see e.g., Day et al., 2015). Time of the observations correlated with CM-CF activities at T1 ($r=0.61$, $p=0.001$), indicating that there were more CM-CF activities in the classrooms which were observed later during the first term, but not with any of the other activities in either of the terms. The time when students' skills were assessed correlated with word reading skills at classroom level both at T1 ($r=0.54$, $p=0.003$) and T2 ($r=0.86$, $p=0.004$), but not at the level of individual students. Time of the observation at T1 was included in the models. However, as adding time of the observations to the model did not explain the results in any of the models nor changed the results, it was omitted from the final models for the sake of model parsimony. The models' goodness-of-fit was evaluated using four indicators: the chi-square test, the

Between



Within

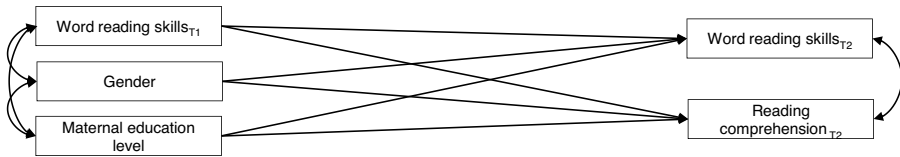


Fig. 1 Schematic representation of the tested model

comparative fit index (CFI), the root mean square error of approximation (RMSEA) and the standardized root mean square residual (SRMR). Good model fit was indicated by a small, preferably non-significant chi-square, CFI > 0.95, RMSEA < 0.06 and SRMR < 0.08 (Hu & Bentler, 1999).

Results

Descriptive statistics and correlation analysis

Table 2 displays the descriptive statistics of the study variables and their correlations. Although the time that the teachers allocated to different activities varied to some extent, the teachers generally emphasised CF activities at T1 and MF activities at T2. Different activities mainly correlated with a specific time point rather than across time points. This is understandable as the percentages of time used for different activities were not independent of each other. Students' word reading skills were strongly correlated both at individual (within level) and classroom levels (between level) and moderately with reading comprehension, respectively.

Reading performance and literacy instruction

Four cross-lagged models were specified to analyse the associations between reading performance and the percentages of TCM-CF, TCM-MF, CM-CF, and CM-MF activities at T1 and T2. Table 3 presents the fit indices of the models. The indices demonstrated a good

Table 2 Descriptive statistics of the study variables and their between- and within-level zero-order correlations

Variable	<i>M</i>	<i>SD</i>	2	3	4	5	6	7	8	9	10	11	12	13
1. TCM-CF (T1)	22.66%	13.10%	-.07	-.53***	-.39**	-.14	.23	.10	-.28	.18	-.00	-.14*	-.13**	-.09
2. TCM-MF (T1)	16.49%	14.70%		-.56***	-.45***	.34	.24	-.06	-.27	.02	.16*	-.02	-.06	.07
3. CM-CF (T1)	27.04%	20.29%			.61***	-.19	-.32	-.11	.45*	-.23	-.09	.19***	.16***	.01
4. CM-MF (T1)	8.07%	18.55%				.14	-.42*	-.06	.13	-.46***	-.03	.09*	.04	-.05
5. TCM-CF (T2)	8.71%	8.91%					-.19	-.07	-.44***	.04	.06	-.07	.00	-.07
6. TCM-MF (T2)	34.22%	16.58%						-.25*	-.37*	.14	-.03	-.06	-.09*	.02
7. CM-CF (T2)	9.54%	12.74%							-.30**	.04	-.08	-.08	-.00	-.08
8. CM-MF (T2)	18.30%	18.41%								.05	-.01	.18***	.10**	.09
9. Teacher's work experience	16.20	9.53									-.04	-.03	.00	-.02
10. Mother's education level ^a	2.86	.32										.19**	.12*	.17**
11. Word reading skills (T1) ^a	2.88	.86										.18**	.14**	.15**
12. Word reading skills (T2) ^a	-.00	.48											.70***	.54***
13. Reading comprehension (T2) ^a	0	1.79											.70***	.55***
14. Student's gender ^b	-.00	.35											.59***	.60***
	0	1.67												
	-.04	.28												
	0	.99												
	1.52	.50												

*** $p < .001$, ** $p < .01$, * $p < .05$;^aBetween- and within-level variable, between-level correlations are presented above the within-level correlations;^bStudent's gender: 1 = girl; 2 = boy;

TCM, teacher/child-managed; CM, child-managed; CF, code-focused; and MF, meaning-focused; means and standard deviations presented as percentages of the total instruction time

Table 3 Model fit indices for the tested cross-lagged models

	Chi-square	<i>df</i>	<i>p</i> -value	CFI	RMSEA	SRMR _{within}	SRMR _{between}
TCM-CF	18.30	21	.63	1.00	.00	.02	.25
TCM-MF	13.00	20	.83	1.00	.00	.02	.19
CM-CF	33.71	20	.03	.97	.04	.02	.28
CM-MF	15.24	22	.85	1.00	.00	.02	.16

TCM teacher/child-managed, *CM* child-managed, *CF* code-focused, and *MF* meaning-focused

model fit (Hu & Bentler, 1999), except for SRMR_{between} for every model and the chi-square test for the CM-CF model.

Individual-level associations of reading skills

For each model, the results at individual student level (within level in Fig. 1) showed that the students' word reading skills at T1 predicted both their word reading skills ($\beta=0.70$, $p<0.001$) and reading comprehension ($\beta=0.56$, $p<0.001$) at T2. Likewise, word reading skills and reading comprehension were correlated at T2 ($r=0.34$, $p<0.001$). While the mothers' education levels were correlated with word reading skills at T1 ($r=0.18$, $p=0.004$), they were not associated with word reading skills or reading comprehension at T2. Girls performed somewhat better in reading comprehension than boys at T2 ($\beta=-0.06$, $p=0.006$). Table 4 displays the results at the classroom level.

Classroom-level associations between literacy instruction and reading skills in TCM-CF model

At classroom level (between level in Fig. 1), students' word reading skills at T1 were marginally associated with students' word reading skills at T2. Furthermore, the percentage of TCM-CF activities marginally significantly decreased between T1 and T2. Students' word reading skills at T1 were marginally significantly associated with reading comprehension at T2. A negative association was found between word reading skills at T1 and TCM-CF activities at T2. The percentage of TCM-CF activities at T1 was not associated with the students' word reading skills or reading comprehension at T2.

Classroom-level associations between literacy instruction and reading skills in TCM-MF model

The word reading skills in classrooms at T1 were marginally significantly associated with word reading skills at T2. Both the students' word reading skills and the percentage of TCM-MF activities at T1 were significantly associated with reading comprehension in classrooms at T2. A positive correlation was found between the word reading skills and reading comprehension at T2 ($r=0.68$, $p=0.009$). A negative correlation was found between the students' word reading skills at T2 and the percentage of TCM-MF activities at T2 ($r=-0.63$, $p=0.010$).

Table 4 Between-Level Associations between the Classroom's Average Reading Performance and the Literacy Instruction Combinations of TCM-CF, TCM-MF, CM-CF and CM-MF at Time 1 and Time 2: Standardised Beta Estimates (above) and Standard Errors (below)

	TCM-CF			TCM-MF			CM-CF			CM-MF		
	WRS _{T2}	RC _{T2}	ISI _{T2}	WRS _{T2}	RC _{T2}	ISI _{T2}	WRS _{T2}	RC _{T2}	ISI _{T2}	WRS _{T2}	RC _{T2}	ISI _{T2}
1. WRS _{T1}	.57†	.42†	-.55***	.56†	.45*	-.47**	.56†	.71***	-.47**	.68***	.42*	.83***
	.32	.23	.16	.30	.20	.16	.34	.13	.16	.17	.18	.14
2. ISI _{T1}			-.24†		.36**			-.41**				
			.14		.14			.15				
3. Maternal education	-.70*			-.54*			-.55†			-.57*		
	.33			.24			.28			.25		

TCM teacher/child-managed, CM child-managed, CF code-focused, MF meaning-focused and ISI Individualizing Student Instruction, combination of management and content (TCM-CF, TCM-MF, CM-CF and CM-MF) used in the model, WRS word reading skills, RC=reading comprehension

Teachers' work experience was controlled for in the analyses;

† < .10, * $p < .05$, ** $p < .01$, *** $p < .001$

Classroom-level associations between literacy instruction and reading skills in CM-CF model

Similarly to the TCM-CF and TCM-MF models, the CM-CF model demonstrated a marginally significant association between the students' word reading skills at classroom level at T1 and T2. Moreover, students' word reading skills at T1 were significantly associated with reading comprehension at T2. As in the TCM-CF model, a negative association was found between word reading skills at T1 and the percentage of CM-CF activities at T2. In addition, the percentage of CM-CF activities at T1 was negatively associated with reading comprehension at T2. The word reading skills were positively correlated ($r=0.92$, $p=0.008$) with reading comprehension at classroom level at T2.

Classroom-level associations between literacy instruction and reading skills in CM-MF model

The students' word reading skills at T1 were significantly associated with all measures at T2: the students' word reading skills at T1 were associated with both word reading skills and reading comprehension as well as with CM-MF activities at T2.

Control variables

In each model, at classroom level, the teachers' work experience was not associated with either the students' reading performance or the different literacy instruction activities at T2. The mothers' education levels were negatively associated with the average word reading skills in classrooms at T2. The results indicated that in the classrooms where mothers had, on average, lower education levels, students demonstrated higher growth in word reading skills. This result, however, must be interpreted with caution, as information regarding education level was missing for nearly 40% of the mothers.

Discussion

The present cross-lagged study investigated the associations between first-grade students' reading performance and different literacy instruction activities observed in classrooms in the autumn and spring terms. The results did not reveal reciprocal associations between the two, but unidirectional associations were found in models examining the associations between students' reading skills and different literacy instruction activities. First, the findings considering the associations between students' word reading skills and the amount of different types of literacy instruction suggest that teachers may adapt their literacy instruction to their students' prior skills also at classroom level, which confirms our hypotheses (H1 & H2). Second, it was found that the amount of the literacy instruction activities (i.e., the combinations of TCM-CF, TCM-MF, CM-CF, and CM-MF activities) in the autumn were not associated with students' word reading skills in the spring aligning with some of the previous studies included in the meta-analysis by Cao et al. (2022). On the contrary, the amount of some activities in the autumn was either positively or negatively associated with students' reading comprehension in

the spring. Thus, the results for the associations between literacy instruction activities and their targeted reading skills supported our hypothesis (H3) only partially.

Prior evidence has documented that Finnish first graders' word reading skills develop rapidly (e.g., Lerkkanen et al., 2004; Soodla et al., 2015). The present study found some evidence that teachers respond to this change by adapting their literacy contents. On average, the teachers' emphasis moved from phonological recoding activities (e.g., to improve reading and spelling acquisition) in the autumn to sentence- and text-level activities in the spring. However, entry-level word reading skills in the classrooms were associated with the allocation of lesson time to different literacy instruction activities above general shifts in instruction from autumn to spring. Higher word reading skills in classrooms (i.e., there were more students who could already read) in the autumn were associated with the teachers allotting more time for CM-MF tasks, such as independent reading and comprehension tasks, in the spring. As word reading skill is a crucial skill with a high instrumental value for learning in later years, lower word reading skills (i.e., there were more beginning readers) in the classroom seemed to signal for the teachers to continue to provide strong support for consolidation of accurate and fluent reading.

Compared to the earlier findings by Carlisle et al. (2011) and Ruotsalainen et al. (2022a), the results provided some similar findings considering the classrooms with higher entry-level skills as more time was allocated to independent work. In the classrooms with lower entering skills, on average, differences were found compared to Ruotsalainen, Pakarinen et al. study that focused only on first grade autumn: in the autumn, more time was spent in TCM activities, that is whole group activities led by the teacher, whereas the content of the instruction was more determinant factor in the spring. Our results concerning word reading skills support the findings of Kikas et al. (2018) on the reciprocal relationships between students' skills and instructional practices.

Prior studies have not identified association between TCM-MF activities and students' word reading skills at classroom level at school entry (Ruotsalainen et al., 2022a). The present findings suggest, however, that these activities may be associated with better reading comprehension among students in the spring — thus providing support for earlier studies of the importance of this type of instruction for students reading comprehension (Connor et al., 2020; Kikas et al., 2018; Lerkkanen et al., 2016). It has been claimed that the sheer amount of MF activities does not reflect their quality (Baker et al., 2020; Lennox, 2013). More time spent in TCM-MF activities may, however, facilitate a broader range of activities that support students' vocabulary and comprehension skills development, especially at the beginning of the first grade. High quality MF activities involve, for example, a teacher's use of questions to activate their students' prior knowledge, their use of prompts and allowing of questions during the reading as well as their guidance of the students' understanding of the story and the vocabulary after the reading (Baker et al., 2020). Students' experience of such activating practices is likely to differ from when the teacher merely reads the text to the students.

Somewhat mixed findings were found regarding the associations between CM-CF activities and reading performance. Despite the high positive correlation between word reading skills and the amount of CM-CF activities in the autumn, the amount of CM-CF activities in the autumn was not associated with students' word reading skills in the spring. Instead, a negative association was found between CM-CF activities in the autumn and reading comprehension in the spring. Caution, however, is warranted in interpreting this result. Word reading skills are vital for reading comprehension among beginning readers (Torppa et al., 2016), and this type of practicing may show benefits on reading comprehension only a year later (Schwanenflugel et al., 2009). However, an exclusive or overly

strong emphasis on word reading skills may take time away from age-adapted MF activities (e.g., those targeting vocabulary or understanding of the texts) and thus hinder the development of young students' reading comprehension skills (Connor et al., 2004, 2013; Kikas et al., 2018; Lerkkanen et al., 2016). Moreover, even though well-integrated code-focused instruction is needed to consolidate word reading skills as a basis for later comprehension skills, too many repetitive exercises may contribute to students' off-task behaviour (Ponitz & Rimm-Kaufman, 2011; Schwanenflugel et al., 2009) and decrease their interest in the literacy contents (Kikas et al., 2018), both of which may lead to inefficient reading practice. Consequently, future studies should assess the optimal amount of CM-CF activities in line with students' reading skills, which would likely require a longer follow-up period (Connor et al., 2013; Schwanenflugel et al., 2009).

This study focused on the content and management of the literacy instruction and their associations with students' reading skills. However, there are other aspects in the students' skills that might have affected the results. For example, Ponitz and Rimm-Kaufman (2011) showed that students were more likely to be off task during CM instruction than TCM instruction. As reading precursors are shown to be associated with self-regulation (Guedes et al., 2023; Lepola et al., 2016), it is possible that students' self-regulation skills together with better initial reading skills enabled the teachers to provide more lesson time for independent practicing of reading. More holistic view of different skills and instructional activities is required in the future.

Limitations and future directions

This study has some limitations that need to be considered. First, the study is exploratory in nature as the data of the current study came from 30 classrooms with two literacy lessons (one in the autumn and one in the spring) observed in each of the classrooms. This also sets limitations for the analyses. With only two time points, possibilities to draw conclusions on the causality of associations between literacy skills and instructional activities are limited. The selected cross-lagged modelling has also been criticised for ignoring stable-trait variance in the variables increasing the possibility for spurious cross-lagged associations (Hamaker et al., 2015; Lucas, 2023). Thus, causal claims between students' reading performance and literacy instruction cannot be made based on these findings and the results must be interpreted cautiously. It should be also noted that the cross-lagged associations between the students' reading comprehension skills and literacy instruction were not examined, as the students' reading comprehension was assessed only in the spring.

Second, as only one literacy lesson per classroom per semester was video recorded and coded, the results did not capture the complete spectrum of literacy instruction activities in these classrooms. The teachers were asked to be observed during three lessons (e.g. literacy, math, science) on regular school days. Thus, even if the teachers were not told that their literacy practices were to be observed, it is possible that the observations may have somehow influenced their instruction. The use of broad content categories of CF and MF provided robust estimates of classroom contents that were expected to support different skills (Connor & Morrison, 2016), but long-term and finer-tuned analyses are necessary to capture more subtle changes in teachers' instruction and adaptations to their students' reading skill development. As these adaptations can be seen both in lesson plans and in more fine-tuned adaptations to student responses during the lessons (see e.g., Hardy et al., 2019), combinations of both aspects would be beneficial to better understand the phenomenon.

Third, the present study focused on the classroom-level processes rather than individual-level associations (e.g., Connor et al., 2009, 2013). Hence, future studies would benefit from combining the classroom and individual levels to better understand the multifaceted nature of literacy learning and teaching in the classroom context. It would be important to investigate, whether the associations between instruction and reading skills differ if the associations are investigated at the student or classroom level and whether these associations are similar for different reading skills (e.g., word reading skills or reading comprehension). The present study focused on the classroom-level associations between literacy instruction and students' skills. Future studies would benefit from including other student characteristics to the study design. In addition to students' self-regulation skills, a continuous topic in Finland is existing gender difference in reading (Organisation for Economic Co-operation and Development [OECD], 2019), which, despite small difference at first grade, increases with age during the compulsory 9-year comprehensive school (Manu et al., 2023). Thus, future studies should examine whether diversity in students, including gender, affects associations between instruction and reading skills.

Fourth, this study was conducted in the Finnish context, in which the onset of formal reading instruction is late relative to many other educational systems. This timing of the children's school entry together with transparent orthography of Finnish language (Seymour et al., 2003) leads to rapid reading acquisition. Thus, the association between classroom reading levels and instruction should be examined in other contexts as well.

Conclusion

The findings provide support for teachers' sensitivity to their students' reading skills at the classroom level. In addition, the findings provided support for earlier studies that teachers should include whole-group MF activities such as vocabulary and text activities already when all students are not yet fluent readers to support their reading comprehension development. Future research should examine the longitudinal associations between students' literacy learning and teachers' instructional choices. More specifically, more research is needed to examine whether the associations are different for word reading skills and reading comprehension.

The findings also provide suggestions on how teachers can adapt their instruction to serve both individual students and the classroom as a whole. By focusing on the classroom level, teachers can determine if students with low initial reading skills receive enough CF practice in classrooms with high entry-level reading skills and if students who could read fluently before school entry are challenged enough in classrooms with beginning readers. Future research should address the contents and language experiences that can be effectively offered to all students in a classroom and determine when more individualised approaches and differentiation are required. This information could also be used in teachers' pre- and in-service training to support teachers' ability to adjust their instruction to their students' needs. These concerns are, thus, critical for both practitioners and researchers in the search of the most effective practices to support students' literacy development during their early school years.

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References

- Al Otaiba, S., McMaster, K., Wanzek, J., & Zary, M. W. (2023). What we know and need to know about literacy interventions for elementary students with reading difficulties and disabilities, including dyslexia. *Reading Research Quarterly*, 58(2), 313–332. <https://doi.org/10.1002/rrq.458>
- Baker, D. L., Santoro, L., Biancarosa, G., Baker, S. K., Fien, H., & Otterstedt, J. (2020). Effects of a read aloud intervention on first grade student vocabulary, listening comprehension, and language proficiency. *Reading and Writing*, 33, 2697–2724. <https://doi.org/10.1007/s11145-020-10060-2>
- Cao, Y., Kim, Y.-S. G., & Cho, M. (2022). Are observed classroom practices related to student language/literacy achievement? *Review of Educational Research*, 0(0). <https://doi.org/10.3102/00346543221130687>
- Carlisle, J., Kelcey, B., Berebitsky, D., & Phelps, G. (2011). Embracing the complexity of instruction: a study of the effects of teachers' instruction on students' reading comprehension. *Scientific Studies of Reading*, 15(5), 409–439. <https://doi.org/10.1080/10888438.2010.497521>
- Connor, C. M., & Morrison, F. J. (2016). Individualizing student instruction in reading: implications for policy and practice. *Policy Insights from the Behavioral and Brain Sciences*, 3(1), 54–61. <https://doi.org/10.1177/2372732215624931>
- Connor, C. M., Morrison, F. J., & Katch, L. E. (2004). Beyond the reading wars: exploring the effect of child–instruction interactions on growth in early reading. *Scientific Studies of Reading*, 8(4), 305–336. https://doi.org/10.1207/s1532799xssr0804_1
- Connor, C. M., Morrison, F. J., Fishman, B. J., Ponitz, C. C., Glasney, S., Underwood, P. S., Piasta, S. B., Coyne Crowe, E., & Schatschneider, C. (2009). The ISI classroom observation system: examining the literacy instruction provided to individual students. *Educational Researcher*, 38(2), 85–99. <https://doi.org/10.3102/0013189X09332373>
- Connor, C. M., Morrison, F. J., Fishman, B., Crowe, E. C., Al Otaiba, S., & Schatschneider, C. (2013). A longitudinal cluster-randomized controlled study on the accumulating effects of individualized literacy instruction on students' reading from first through third grade. *Psychological Science*, 24(8), 1408–1419. <https://doi.org/10.1177/0956797612472204>
- Connor, C. M., Kelcey, B., Sparapani, N., Petscher, Y., Siegal, S. W., Adams, A., Hwang, J. K., & Carlisle, J. F. (2020). Predicting second and third graders' reading comprehension gains: observing students' and classmates talk during literacy instruction using COLT. *Scientific Studies of Reading*, 24(5), 411–433. <https://doi.org/10.1080/10888438.2019.1698583>
- Connor, C. M., Piasta, S., Al Otaiba, S., Day, S., Morrison, F. J. & Cameron, C. (2010). *Individualizing student instruction*. Classroom observations coding manual. Version 40.11.02.2010. Tallahassee, FL: Florida State University and the Florida Center for Reading Research. Ann Arbor, MI: University of Michigan.
- Corno, L. (2008). On teaching adaptively. *Educational Psychologist*, 43(3), 161–173. <https://doi.org/10.1080/00461520802178466>
- Day, S. L., Connor, C. M., & McClelland, M. M. (2015). Children's behavioral regulation and literacy: the impact of the first grade classroom environment. *Journal of School Psychology*, 53(5), 409–428. <https://doi.org/10.1016/j.jsp.2015.07.004>

- De Jong, P. F., & van der Leij, A. (2002). Effects of phonological abilities and linguistic comprehension on the development of reading. *Scientific Studies of Reading*, 6(1), 51–77. https://doi.org/10.1207/S1532799XSSR0601_03
- Finnish National Agency for Education. (2016). *National core curriculum for basic education 2014*. Helsinki: Finnish National Agency for Education.
- Florit, E., & Cain, K. (2011). The simple view of reading: Is it valid for different types of alphabetic orthographies? *Educational Psychology Review*, 23, 553–576. <https://doi.org/10.1007/s10648-011-9175-6>
- Foorman, B. R., Francis, D. J., Fletcher, J. M., Schatschneider, C., & Mehta, P. (1998). The role of instruction in learning to read: preventing reading failure in at-risk children. *Journal of Educational Psychology*, 90(1), 37–55. <https://doi.org/10.1037/0022-0663.90.1.37>
- Gough, P. B., & Tunmer, W. E. (1986). Decoding, reading, and reading disability. *RASE: Remedial & Special Education*, 7, 6–10. <https://doi.org/10.1177/074193258600700104>
- Guedes, C., Ferreira, T., Leal, T., & Cadima, J. (2023). Unique and joint contributions of behavioral and emotional self-regulation to school readiness. *Applied Developmental Science*, 27(2), 136–155. <https://doi.org/10.1080/10888691.2022.2045200>
- Hamaker, E. L., Kuiper, R. M., & Grasman, R. P. P. P. (2015). A critique of the cross-lagged panel model. *Psychological Methods*, 20(1), 102–116. <https://doi.org/10.1037/a0038889>
- Hardy, I., Decristan, J., & Klieme, E. (2019). Adaptive teaching in research on learning and instruction. *Journal for Educational Research Online*, 11(2), 169–191.
- Häyrynen, T., Serenius-Sirve, S., & Korkman, M. (1999). *Lukilasse – Lukemisen, kirjoittamisen ja laskemisen seuloontesti 1-6 vuosiluokille [Test for reading, spelling and arithmetics for Grades 1-6]*. Helsinki: Psykologien kustannus.
- Hu, L., & Bentler, P. M. (1999). Cutoff criteria for fit indexes in covariance structure analysis: conventional versus new alternatives. *Structural Equation Modeling*, 6(1), 1–55. <https://doi.org/10.1080/10705519909540118>
- Jaeger, E. L. (2016). Negotiating complexity: A bioecological systems perspective on literacy development. *Human Development*, 59(4), 163–187. <https://doi.org/10.1159/000448743>
- Juel, C., & Minden-Cupp, C. (2000). Learning to read words: linguistic units and instructional strategies. *Reading Research Quarterly*, 35(4), 458–492. <https://doi.org/10.1598/RRQ.35.4.2>
- Kikas, E., Pakarinen, E., Soodla, P., Peets, K., & Lerkkanen, M.-K. (2018). Associations between reading skills, interest in reading, and teaching practices in first grade. *Scandinavian Journal of Educational Research*, 62(6), 832–849. <https://doi.org/10.1080/00313831.2017.1307272>
- Lennox, S. (2013). Interactive read-alouds—An avenue for enhancing children’s language for thinking and understanding: a review of recent research. *Early Childhood Education Journal*, 41, 381–389. <https://doi.org/10.1007/s10643-013-0578-5>
- Lepola, J., Lynch, J., Kiuru, N., Laakkonen, E., & Niemi, P. (2016). Early oral language comprehension, task orientation, and foundational reading skills as predictors of grade 3 reading comprehension. *Reading Research Quarterly*, 51(4), 373–390. <https://doi.org/10.1002/rrq.145>
- Lerkkanen, M.-K., Rasku-Puttonen, H., Aunola, K., & Nurmi, J.-E. (2004). Predicting reading performance and the second year of primary school. *British Educational Research Journal*, 30(1), 67–92. <https://doi.org/10.1080/01411920310001629974>
- Lerkkanen, M.-K., Kiuru, N., Pakarinen, E., Poikkeus, A.-M., Rasku-Puttonen, H., Siekkinen, M., & Nurmi, J.-E. (2016). Child-centered versus teacher-directed teaching practices: Associations with the development of academic skills in the first grade at school. *Early Childhood Research Quarterly*, 36(3), 145–156. <https://doi.org/10.1016/j.ecresq.2015.12.023>
- Lerkkanen, M.-K., & Pakarinen, E. (2016–2022). *Teacher and Student Stress and Interaction in Classroom (TESSI) study*. <https://doi.org/10.17011/jyx/dataset/77741>
- Lerkkanen, M.-K., Poikkeus, A.-M., & Ketonen, R. (2006). *ARMI – Luku- ja kirjoitustaidon arviointimateriaali 1. luokalle [ARMI – A tool for assessing reading and writing skills in grade 1]*. Helsinki: WSOY.
- Lindeman, J. (1998). *ALLU – Ala-asteen lukutesti [ALLU – Reading Test for Primary School]*. University of Turku.
- Linnakylä, P., Välijärvi, J., & Arffman, I. (2007). Reading literacy – high quality by means of equity. In P. Linnakylä & I. Arffman (Eds.), *Finnish reading literacy. When quality and equity meet* (pp. 155–174). Jyväskylä: University of Jyväskylä, Institute for Educational Research.

- Lovett, M. W., Frijters, J. C., Wolf, M., Steinbach, K. A., Sevcik, R. A., & Morris, R. D. (2017). Early intervention for children at risk for reading disabilities: the impact of grade at intervention and individual differences on intervention outcomes. *Journal of Educational Psychology, 109*(7), 889–914. <https://doi.org/10.1037/edu0000181>
- Lucas, R. E. (2023). Why the cross-lagged panel model is almost never the right choice. *Advances in Methods and Practices in Psychological Science, 6*(1). <https://doi.org/10.1177/25152459231158378>
- Manu, M., Torppa, M., Vasalampi, K., Lerkkanen, M.-K., Poikkeus, A.-M., & Niemi, P. (2023). Reading development from kindergarten to age 18: The role of gender and parental education. *Reading Research Quarterly, 58*(4), 505–538. <https://doi.org/10.1002/rrq.518>
- Muthén, L. & Muthén, B.O. (1998–2012). *Mplus users guide*, 7th ed. Los Angeles, CA: Muthén & Muthén.
- Nurmi, J.-E., Kiuru, N., Lerkkanen, M.-K., Niemi, P., Poikkeus, A.-M., Ahonen, T., Leskinen, E., & Lyyra, A.-L. (2013). Teachers adapt their instruction in reading according to individual children's literacy skills. *Learning and Individual Differences, 23*, 72–79. <https://doi.org/10.1016/j.lindif.2012.07.012>
- Official Statistics of Finland [OFS]. (2018). *Educational structure of population* (ISSN=2242–2919). http://www.stat.fi/til/vkour/index_en.html. Accessed 30 Oct 2020.
- Organisation for Economic Co-operation and Development. (2019). PISA 2018 results (Volume II): Where all students can succeed. <https://doi.org/10.1787/b5fd1b8f-en>
- Paris, S. G. (2005). Reinterpreting the development of reading skills. *Reading Research Quarterly, 40*, 184–202. <https://doi.org/10.1598/RRQ.40.2.3>
- Parsons, S., Vaughn, M., Qualls Scales, R., Gallagher, M. A., Parsons, A. W., Davis, S. G., Pierczynski, M., & Allen, M. (2018). Teachers' instructional adaptations: a research synthesis. *Review of Educational Research, 88*(2), 205–242. <https://doi.org/10.3102/0034654317743198>
- Poikkeus, A.-M., Lerkkanen, M.-K., Ruotsalainen, J., & Soodla, P. (2013). Finnish and Estonian adaptation of the ISI Classroom observation system. Based on Individualizing Student Instruction classroom observations coding manual Version 40.11.02.2010 authored by C. M. Connor, S. Piasta, S. Al Otaiba, S. Day, F. J. Morrison, & C. Cameron, 2010 [Unpublished manual]. Jyväskylä: University of Jyväskylä; Tallinn: University of Tallinn.
- Ponitz, C. C., & Rimm-Kaufman, S. E. (2011). Contexts of reading instruction: implications for literacy skills and kindergarteners' behavioral engagement. *Early Childhood Research Quarterly, 26*(2), 157–168. <https://doi.org/10.1016/j.ecresq.2010.10.002>
- Pressley, M., Wharton-McDonald, R., Allington, R., Collins Block, C., Morrow, L., Tracey, D., et al. (2001). A study of effective first-grade literacy instruction. *Scientific Studies of Reading, 5*(1), 35–58. https://doi.org/10.1207/S1532799XSSR0501_2
- Rasinski, T.V., Yates, R., Foerg, K., Greene, K., Paige, D., Young, C., & Rupley, W. (2020). Impact of classroom-based fluency instruction on grade one students in an urban elementary school. *Education Sciences, 10*(9). <https://doi.org/10.3390/educsci10090227>
- Ruotsalainen, J., Pakarinen, E., Poikkeus, A.-M., & Lerkkanen, M.-K. (2022a). Literacy instruction in first grade: classroom-level associations between reading skills and literacy instruction activities. *Journal of Research in Reading, 45*(1), 83–99. <https://doi.org/10.1111/1467-9817.12384>
- Ruotsalainen, J., Soodla, P., Räikkönen, E., Poikkeus, A.-M., Kikas, E., & Lerkkanen, M.-K. (2022b). Literacy instruction activities and their associations with first graders' reading performance in two transparent orthographies. *Compare: A Journal of Comparative and International Education, 52*(1), 92–109. <https://doi.org/10.1080/03057925.2020.1742093>
- Schwanenflugel, P. J., Kuhn, M. R., Morris, R. D., Morrow, L. M., Meisinger, E. B., Woo, D. G., & Sevcik, R. (2009). Insights into fluency instruction: short- and long-term effects of two reading programs. *Literacy Research and Instruction, 48*(4), 318–336. <https://doi.org/10.1080/19388070802422415>
- Seymour, P. H. K., Aro, M., & Erskine, J. M. (2003). Foundation literacy acquisition in European orthographies. *British Journal of Psychology, 94*(2), 143–174. <https://doi.org/10.1348/000712603321661859>
- Soodla, P., Lerkkanen, M.-K., Niemi, P., Kikas, E., Silinskas, G., & Nurmi, J.-E. (2015). Does early reading instruction promote the rate of acquisition? A comparison of two transparent orthographies. *Learning and Instruction, 38*, 14–23. <https://doi.org/10.1016/j.learninstruc.2015.02.002>
- Sunde, K., Furnes, B., & Lundstræ, K. (2019). Does introducing the letters faster boost the development of children's letter knowledge, word reading and spelling in the first year of school? *Scientific Studies of Reading, 24*(2), 141–158. <https://doi.org/10.1080/10888438.2019.1615491>

- Torppa, M., Georgiou, G. K., Lerkkanen, M.-K., Niemi, P., Poikkeus, A.-M., & Nurmi, J.-E. (2016). Examining the simple view of reading in a transparent orthography: a longitudinal study from kindergarten to grade 3. *Merril-Palmer Quarterly*, 62, 179–206. <https://doi.org/10.13110/merrpalmquar1982.62.2.0179>
- Ukkola, A. & Metsämuuronen, J. (2019). *Alkumittaus – matematiikan ja äidinkielen ja kirjallisuuden osaaminen ensimmäisen luokan alussa [Pre-measurement – students' skills in mathematics and literacy in the beginning of grade 1]*. Finnish Education Evaluation Centre, Publications 17:2019. <https://karvi.fi/publication/alkumittaus-matematiikan-ja-aidinkielen-ja-kirjallisuuden-osaaminen-ensimmaisenuokan-alussa/>. Accessed 19 Oct 2020.
- Van de Pol, J., Volman, M., & Beishuizen, J. (2010). Scaffolding in teacher–student interaction: a decade of research. *Educational Psychology Review*, 22, 271–296. <https://doi.org/10.1007/s10648-010-9127-6>
- Vaughn, M. (2019). Adaptive teaching during reading instruction: a multi-case study. *Reading Psychology*, 40(1), 1–33. <https://doi.org/10.1080/02702711.2018.1481478>

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Current themes of research:

Reading skill development. Literacy instruction. Home literacy environment. Associations between the child's skills and the home and school contexts.

Most relevant publications in the field of Psychology of Education:

- Ruotsalainen, J., Pakarinen, E., Poikkeus, A.-M., & Lerkkanen, M.-K. (2022). Literacy instruction in first grade: classroom-level associations between reading skills and literacy instruction activities. *Journal of Research in Reading*, 45(1), 83–99. 10.1111/1467-9817.12384
- Ruotsalainen, J., Soodla, P., Räikkönen, E., Poikkeus, A.-M., Kikas, E., & Lerkkanen, M.-K. (2022). Literacy instruction activities and their associations with first graders' reading performance in two transparent orthographies. *Compare: A Journal of Comparative and International Education*, 52(1), 92–109. 10.1080/03057925.2020.1742093

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Current themes of research:

Teacher-student interactions. Teacher-student relationship. Teacher and student wellbeing in relation to students' motivational, academic, and socio-emotional outcomes.

Most relevant publications in the field of Psychology of Education:

- Jögi, A.-L., Pakarinen, E., Tolvanen, A., & Lerkkanen, M.-K. (2022). Reading Skills, Social Competence, and Physiological Stress in the First Grade. *School Mental Health*, 14(3), 624–639. 10.1007/s12310-021-09487-x
- Lerkkanen, M.-K., Pakarinen, E., Salminen, J., & Torppa, M. (2023). Reading and math skills development among Finnish primary school children before and after COVID-19 school closure. *Reading and Writing*, 36(2), 263–288. 10.1007/s11145-022-10358-3
- Pakarinen, E., Lerkkanen, M.-K., Viljaranta, J., & Suchodoletz, A. v. (2021). Investigating bidirectional links between the quality of teacher–child relationships and children's interest and pre-academic skills in literacy and math. *Child Development*, 92, 388–407. 10.1111/cdev.13431
- Ruotsalainen, J., Pakarinen, E., Poikkeus, A.-M., & Lerkkanen, M.-K. (2022). Literacy instruction in first grade: classroom-level associations between reading skills and literacy instruction activities. *Journal of Research in Reading*, 45(1), 83–99. 10.1111/1467-9817.12384

Tang, X., Kikas, E., Pakarinen, E., Laursen, B., & Lerkkanen, M. (2022). Longitudinal associations between third-grade teaching styles and sixth-grade reading skills: a 3-year follow-up study. *Journal of Research in Reading*, 45(1), 157–169. 10.1111/1467-9817.12385

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Current themes of research:

How motivation, home environment and teacher–student relationships influence young children's skill development in the areas of reading and math, social skills, and self-regulation. Paths of children with and without risks for learning problems. Intervention studies for families of young children with self-regulation problems. Teacher intervention for supporting student's active engagement and dialogue in the classroom. Assessment of student agency.

Most relevant publications in the field of Psychology of Education:

- Jääskelä, P., Tolvanen, A., Marín, V. I., & Poikkeus, A.-M. (2023). Assessment of students' agency in Finnish and Spanish university courses: Analysis of measurement invariance. *International Journal of Educational Research*, 118, Article 102140. 10.1016/j.ijer.2023.102140
- Hartikainen, J., Haapala, E. A., Poikkeus, A.-M., Sääkslahti, A., Laukkanen, A., Gao, Y., & Finni, T. (2023). Classroom-based physical activity and teachers' instructions on students' movement in conventional classrooms and open learning spaces. *Learning Environments Research*, 26(1), 177–198. 10.1007/s10984-022-09411-3
- Haapala, E. A., Widlund, A., Poikkeus, A.-M., Lima, R. A., Brage, S., Aunio, P., & Lakka, T. A. (2023). Cross-Lagged Associations between Physical Activity, Motor Performance, and Academic Skills in Primary-School Children. *Medicine and Science in Sports and Exercise*, Ahead of Print. 10.1249/MSS.0000000000003163
- Psyridou, M., Tolvanen, A., Patel, P., Khanolainen, D., Lerkkanen, M.-K., Poikkeus, A.-M., & Torppa, M. (2023). Reading Difficulties Identification : A Comparison of Neural Networks, Linear, and Mixture Models. *Scientific Studies of Reading*, 27(1), 39–66. 10.1080/10888438.2022.2095281
- Metsäpelto, R.-L., Poikkeus, A.-M., Heikkilä, M., Husu, J., Laine, A., Lappalainen, K., Lähteenmäki, M., Mikkilä-Erdmann, M., Warinowski, A., Iiskala, T., Hangelin, S., Harmoinen, S., Holmström, A., Kyrö-Ämmälä, O., Lehesvuori, S., Mankki, V., & Suvilehto, P. (2022). A multidimensional adapted process model of teaching. *Educational Assessment, Evaluation and Accountability*, 34(2), 143–172. 10.1007/s11092-021-09373-9

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Current themes of research:

Individual, family, and teacher factors contributing to children's academic learning and motivation in preschool and through the school years. Developmental trajectories of young children's reading and math skills and the effects of instruction, learning interaction, motivation, and teacher-parents partnership to child's learning.

Most relevant publications in the field of Psychology of Education:

- Lerkkanen, M.-K., Pakarinen, E., Salminen, J., & Torppa, M. (2022). Reading and Math Skills Development among Finnish Primary School Children before and after COVID-19 School Closure. *Reading and Writing*. 10.1007/s11145-022-10358-3
- Virinkoski, R., Lerkkanen, M.-K., Eklund, K., & Aro, M. (2022) Special Education Teachers' Identification of Students' Reading Difficulties in Grade 6. *Scandinavian Journal of Educational Research*, 66 (1), 59–72. 10.1080/00313831.2020.1833241

- Vataja, P., Lerkkanen, M.-K., Aro, M., Westerholm, J., Risberg, A.-K., & Salmi, P. (2022). The development of literacy skills among monolingual and bilingual Finnish-Swedish children during the first grade. *Scandinavian Journals of Educational Research*, 66(6), 960–976. 10.1080/00313831.2021.1942191
- Jögi, A.-L., Pakarinen, E., Tolvanen, A., & Lerkkanen, M.-K. (2021). Reading skills, social competence and physiological stress in the first grade. *School Mental Health*. 10.1007/s12310-021-09487-x
- Lerkkanen, M.-K., & Pakarinen, E. (2021). Parental Trust in Teachers and Children's Interest in Reading and Math: A Longitudinal Study. *European Education*, 53(3–4), 152–167. 10.1080/10564934.2022.2080562
- Lerkkanen, M.-K. (2019). Early language and literacy development in the Finnish context. In D. Whitebread (Eds.). *The Sage Handbook of Developmental Psychology and Early Childhood Education* (pp. 403–417). Sage. 10.4135/9781526470393

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