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General and special education teachers' knowledge about reading comprehension processes and instructional practices

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Abstract
The study investigated teachers' knowledge of reading comprehension processes and reading comprehension instruction. The study was carried out among teachers ($N=65$) in Estonia. The content analysis classified qualitative data from semi-structured interviews as quantitative data. The results showed that teachers' content knowledge about reading comprehension processes and pedagogical knowledge of reading comprehension instruction were considerably variable yet mostly limited. Special education teachers ($n=37$) mentioned a wider range of reading strategies than classroom teachers ($n=28$). When describing how to support struggling readers, significant differences emerged between the teacher groups: Special education teachers mentioned activities to support students' reading comprehension more frequently than classroom teachers whereas classroom teachers mentioned activities for supporting reading motivation more often than special education teachers. Teachers' lack of knowledge about reading comprehension processes and reading comprehension instruction indicate the need to improve these topics in preservice and in-service teacher training to enhance their teaching skills.

Keywords Teachers' knowledge · Reading comprehension · Reading comprehension strategies · Reading comprehension instruction · Content analysis

Introduction

Reading comprehension (RC) constitutes one of the most important cognitive skills students acquire during their education. However, there are many students who have difficulties in understanding texts (OECD, 2019). Moreover, studies have indicated

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that teachers lack knowledge about several important concepts needed to teach struggling readers (Aro & Björn, 2016; Moats & Foorman, 2003; Washburn et al., 2011), particularly poor comprehenders (Anmarkrud & Bråten, 2012; Barron et al., 2018).

A considerable number of studies have examined teachers' knowledge of lower-level RC processes, such as decoding, reading fluency, and vocabulary knowledge (McCutchen et al., 2009; Moats & Foorman, 2003; Van den Hurk et al., 2017; Washburn et al., 2011). Less attention has focused on teachers' knowledge about higher-level RC processes, such as RC strategies (Anmarkrud & Bråten, 2012; Sampson et al., 2013). A few comparative studies have examined classroom teachers' and special education teachers' reading-related knowledge (McCombes-Tolis & Feinn, 2008; Washburn et al., 2017), but studies explicitly comparing special education teachers' and classroom teachers' knowledge about RC processes and reading strategies are lacking.

In this study we investigated classroom and special education teachers' knowledge of RC processes and RC instruction by conducting semi-structured interviews with Estonian teachers. We used content analysis to transform the qualitative data derived from interviews into quantitative data. Teachers' knowledge is important for supporting the development of students with varying knowledge and skills, including those who have difficulties in comprehending texts they read. In many countries, including Estonia, struggling readers study in inclusive classrooms and are taught by classroom teachers, but are also supported by special education teachers. Therefore, we focused on reading-related knowledge of teachers with different professional background—classroom teachers and special education teachers. Differences between these groups can be anticipated due to differences in their training and daily work.

Reading comprehension process

RC is a multifaceted process where the reader transforms textual information into a mental representation. One of the most comprehensive RC models is the construction-integration model, which accounts for the complexity of the metacognitive processes involved in reading from word identification to text comprehension (Kintsch, 2013). The model replaces the text's exact wording with the ideas or propositions derived directly from the text, called *textbase.* Next, readers construct the *situation model*, where the information provided by the text is integrated with their prior knowledge. During the construction phase, several plausible meanings are constructed in parallel to produce a propositional network of the text content; in the integration phase, that network is cleaned up based on the reader's prior knowledge and experience. Hence, readers may form widely different situation models depending on their interests and purposes in reading, their background knowledge and experience, and the text itself (Kintsch, 2013).

In line with models that account for cognitive and linguistic processes involved in RC (e.g., Kintsch, 2013), Kendeou et al. (2014) divided cognitive processes during RC into two levels. Lower-level processes (e.g., decoding, reading fluency,

and vocabulary knowledge) translate the written code into meaningful language units. Higher-level processes combine those language units into a meaningful and coherent mental representation. With respect to higher-level processes, research has demonstrated that limitations in inference-making skills (Cain & Oakhill, 1999), comprehension monitoring (Oakhill et al., 2005), and understanding of a text structure (Oakhill & Cain, 2007) are related to children's RC difficulties. Weaknesses in making inferences are mostly expressed by difficulties in making connections between text elements and background knowledge. In addition to content knowledge of text, knowledge about text structure is considered background knowledge that students need to make inferences (Kendeou et al., 2014).

Comprehension monitoring is the ability to monitor understanding of the text and take appropriate steps to remedy the problem when inadequate comprehension occurs (Oakhill & Cain, 2007). For example, the reader uses RC strategies—the mental activities the reader selects to acquire, organize, and elaborate information as well as reflect on and guide their own text comprehension (Andreassen & Bråten, 2011). Think-aloud studies have identified more than 100 different reading strategies readers use before reading, during the reading process, and after the front-to-back reading of the text (Pressley, 2002; Pressley & Afflerbach, 1995). Strømsø et al. (2003) captured reading strategies using the broader categories of memorization (e.g., remembering, retelling), organization (e.g., summarizing, visualizing), elaboration (e.g., activating prior knowledge, predicting, previewing text), and monitoring (e.g., monitoring, clarifying, questioning, target reading, setting purposes, evaluating text, identifying the main idea).

Lower- and higher-level processes are coordinated by cognitive processes (e.g., working memory and inhibition) that regulate and control our behavior while operating a particular task, also called executive functions (Kendeou et al., 2014). Hence, RC difficulties are also related to working memory capacity (Cain et al., 2004) and poor cognitive control, such as poor strategic planning and organizing (Locascio et al., 2010). Furthermore, limitations in mostly lower-level processes may cause difficulties in RC because lower-level processes exhaust attentional and working memory resources and render the input (a meaningful message) to higher-level processes inaccurate or incomplete (Perfetti & Stafura, 2014).

In addition to several cognitive and metacognitive skills and processes, RC is related to motivation. Reading motivation is described as a drive to read, for internal or external purposes, that comes from an individual's comprehensive set of goals for, beliefs about, and attitudes toward reading (see Conradi et al., 2014). Numerous studies have revealed that reading motivation is associated with students' RC (for an overview, see Toste et al., 2020). Children who believe in their capabilities and see reading as a desirable activity tend to invest more time and effort in fully understanding texts, thereby developing better reading skills (Becker et al., 2010; Guthrie et al., 2007). The relation between higher-level reading skills and motivational beliefs seems reciprocal, since better metacognitive knowledge of reading strategies not only improves RC, but also enhances self-efficacy in reading, leading to positive reading attitudes toward recreational reading (Kolić-Vehovec et al., 2014).

Supporting reading comprehension development

To support development of students' RC, teachers need both content knowledge about RC processes and pedagogical knowledge about RC instruction. Teachers can use many techniques to improve students' RC by supporting lower-level skills related to RC, such as decoding (Kendeou et al., 2009), reading fluency (Fuchs et al., 2001), and vocabulary knowledge (Wright & Cervetti, 2017). Research has confirmed that decoding skills can be improved through phonological-based interventions that contain training in phoneme awareness, letter knowledge, explicit and systematic instruction in phonics, and the implementation of these skills in reading and writing tasks (for an overview, see Duff & Clarke, 2011). The most typical methods for training reading fluency are general reading practice and repeated reading (for an overview, see Huemer, 2009). Effective vocabulary instruction involves directly teaching explicit definitions (e.g., pre-teaching of core vocabulary before reading a text), teaching strategies for understanding words, and supporting students to actively use words (e.g., classifying, comparing, discussing, and mapping the words; for an overview, see Wright & Cervetti, 2017).

RC can also be improved by supporting higher-level RC skills, such as reading strategies (Gersten et al., 2001; Lee & Tsai, 2017). Effective programs for teaching RC strategies most often involve direct and explicit reading strategy instruction and incorporate techniques of metacognitive modelling, collaborative use of the strategy in action, guided practice, and independent use of the strategy so students can reach their fullest potential (Duke & Pearson, 2002). When teaching RC strategies, similar instruction should be used as when teaching different text structures (e.g., narrative text, informational text etc.) and inference making skills (Duke et al., 2011).

In addition to focusing on students' cognitive and metacognitive skills, it is important to consider other aspects of teaching. First, chosen texts should be particularly well suited for the concrete skill or reading strategy being taught. For example, the text should not be too demanding with regard to other components of RC, such as background knowledge, decoding, or vocabulary, when a specific comprehension strategy is being learned (Duke & Pearson, 2002). Second, students' reading motivation needs to be supported. For example, the Concept-Oriented Reading Instruction intervention motivational practices include (a) selecting texts relevant to students, (b) giving students a choice, (c) supporting their self-efficacy, (d) supporting collaboration, and (e) using thematic units that structure the content of reading activities in organized and connected forms. Reading strategies are tools for understanding the texts and should be explicitly taught (Guthrie et al., 2007).

Teachers' knowledge of reading comprehension processes and comprehension instruction

Several studies have indicated the importance of teachers' reading-related knowledge and its relationship to their reading instructional practices and/or students' reading skills in both lower-level processes (Lane et al., 2009; McCutchen et al.,

2009; Piasta et al., 2020) and higher-level processes (Andreassen & Bråten, 2011; Houtveen & Van De Grift, 2007). Other studies suggest that teachers lack knowledge about reading and reading instruction (Anmarkrud & Bråten, 2012; Aro & Björn, 2016; Barron et al., 2018; Moats & Foorman, 2003; Swanson, 2008). Existing studies have examined mostly general education teachers' knowledge while only few studies compare classroom teachers' and special education teachers' reading-related knowledge (as an exception, see Cheesman et al., 2009; McCombes-Tolis & Feinn, 2008; Washburn et al., 2017). Significant differences have been found between general and special education teachers' perceptions of their preparedness and assessment to teach reading (McCombes-Tolis & Feinn, 2008), but not between their knowledge on the topic (Cheesman et al., 2009; Washburn et al., 2017).

A large and growing body of literature has investigated teachers' knowledge about reading, but the focus has been on lower-level processes, such as decoding or related foundational skills (i.e., phonemic awareness), reading fluency, and vocabulary knowledge of RC. A landmark study about teachers' content knowledge of language and reading by Moats (1994) found that in-service teachers from varying backgrounds (speech pathologists, graduate students, general education, and special education teachers) had poor understanding of language constructs relevant in literacy instruction, such as phonemes and morphemes. Numerous studies have subsequently examined teachers' content knowledge (Aro & Björn, 2016; McCutchen et al., 2009; Piasta et al., 2020; Washburn et al., 2011) and pedagogical knowledge regarding lower-level RC processes (Duguay et al., 2016; Van den Hurk et al., 2017). Overall, research on teachers' content and pedagogical knowledge regarding lower-level RC processes indicate that teachers lack knowledge about several important concepts needed to teach struggling readers (Aro & Björn, 2016; Clark et al., 2017; Moats & Foorman, 2003; Washburn et al., 2011).

Teachers' knowledge of higher-level RC processes has been studied less (as exceptions, see Anmarkrud & Bråten, 2012; Barron et al., 2018; Brevik, 2014; Sampson et al., 2013; Taboada & Buehl, 2012), and with contradictory findings. Whereas Taboada and Buehl (2012) found that kindergarten to university-level teachers held views of RC in partial agreement with cognitive views of RC, Anmarkrud and Bråten (2012) conducted interviews showing that language arts teachers ($N=4$) generally expressed a lack of professional knowledge about RC. In teachers' spontaneous descriptions of important skills and processes involved in text comprehension, they each mentioned only one or two aspects; moreover, reading strategies and background knowledge were mentioned only by one participant (Anmarkrud & Bråten, 2012). Research has also indicated that reading strategies are not widely known among teachers. For example, Sampson et al. (2013) found that preservice teachers knew the reading strategies according to the survey, but showed misconceptions when completing their strategy logs and lesson plans. Indeed, more than half of undergraduate preservice teachers mistakenly identified many items (e.g., worksheets) as comprehension strategies in their strategy logs and lesson plans. Furthermore, teachers who included strategies such as context clues and prediction in their lesson plans did not actually identify them as strategies in their logs (Sampson et al., 2013). Similarly, Anmarkrud and Bråten (2012) reported that teachers mentioned only a few reading strategies (e.g., predicting, activating

prior knowledge, summarizing, identifying, and memorizing key concepts in text). Results from classroom observation research also confirmed that the repertoire of strategies that teachers taught was quite narrow (Anmarkrud & Bråten, 2012; Barron et al., 2018).

In studies focusing on teachers' pedagogical knowledge about RC instruction, teachers could not effectively articulate the meaning of comprehension instruction (Barron et al., 2018; Brevik, 2014). Even when teachers might have had the knowledge, they were not explicitly aware of their RC strategy instruction (Brevik, 2014). However, systematic and long-term comprehension strategy instruction did not seem to be a central feature of those teachers' practices (Anmarkrud & Bråten, 2012). These results are similar with Swanson's (2008) review of observational studies of general and special education teachers' reading instruction, revealing low-quality comprehension instruction.

Present study

We conducted this study in Estonia, where teacher education programs follow four curricula in universities: special education, pre-school education, primary school (i.e., classroom teachers), and subject teacher curriculum. For teacher certification, students have to earn a master's degree (see Malva et al., 2020). The principles of inclusive education are applied in Estonia. Students with special needs attend mainstream schools, if possible, and receive part-time special education or attend special classes. If necessary, they attend special schools. Special education teachers or teachers who have received additional training in special education provide special education support for children with special needs. Eligibility for special educational services could be defined within schools or by a counseling committee following a multi-professional evaluation that mostly includes the views of teachers, special education teachers, other needed specialists, and parents (see Padrik & Kikas, 2007). For special education services, formal diagnoses are not needed in most cases. Thus, classroom teachers' and special educators' high competence in identifying students with special needs, as well as effective collaboration skills, are crucial for ensuring adequate support for students.

In Estonia, 15-year-old students have shown high RC results on recent PISA survey (OECD, 2019). Thus, we might also expect Estonian teachers to have good knowledge about RC processes and instruction. However, little is known about teachers' reading-related knowledge in Estonia (as an exception, see Soodla et al., 2017). Thus, in this study we investigated teachers' knowledge of RC processes and instruction by focusing on three research questions: (1) What knowledge do teachers possess about RC processes and how is their knowledge related to their professional background? (2) What knowledge do teachers possess about RC strategies and how is their knowledge related to their professional background? (3) What knowledge do teachers possess about RC instruction and how is their knowledge related to their professional background? We analyzed differences between classroom and special education teachers because these teachers have different training, but both are involved in the instruction of reading skills, although special education

teachers focus primarily on supporting students with reading difficulties. Classroom and special education teachers' knowledge is important, especially in inclusive classrooms with students with varied reading skills, as both groups of teachers have to monitor students' development sufficiently and tailor their own teaching activities accordingly.

Method

Participants

The sample ($N=65$) consisted of classroom teachers ($n=28$) and special education teachers ($n=37$). Most teachers ($n=57$, 88%) worked in Grades 1 to 4; some worked in Grades 6 to 9 ($n=8$, 12%). All classroom teachers worked in general education classrooms. Most special education teachers ($n=21$, 57%) worked in special classes providing full-time special education support, although nine (24%) worked as classroom teachers in general education classrooms and as special education teachers providing part-time special education support, three (8%) provided only part-time special education support, and four (11%) only worked as classroom teachers in general education classrooms. All teachers were White and Estonian native speakers. The age of the participants at the time of the interviews ranged from 24 to 66 years ($M=45.03$, $SD=12.05$), and all but one were female. The teachers had finished their education at a higher education institute; all special education teachers had a master's degree in special education whereas classroom teachers had a master's degree in primary (71%) or pre-primary education (7%) or professional higher education in primary or pre-primary education (21%). The participants were active teachers at 30 different general or special education schools across Estonia. Their teaching experience ranged from 0.5 to 43 years ($M=18.96$, $SD=12.58$). Eight (12%) teachers had 0–5 years of experience, 19 (29%) had 6–15 years of experience, and 38 (59%) had 16 or more years of experience. The distributions of the lengths of teaching experience in classroom versus special education teachers were similar based on Fisher's exact test ($p=0.87$).

Measure

A semi-structured interview was used to examine teachers' knowledge, because it allowed for prompting questions without giving teachers any clues about expected answers. The interview questions were part of a larger interview. The interview for this study contained two parts. The first part gathered background information about teachers' qualifications, teaching experience, and age, and the second part focused on RC processes, strategies, and instruction (adapted from Anmarkrud & Bråten, 2012).

The first research question was examined using two interview questions: *What do you think is important for good text comprehension? Are there any other factors important for good text comprehension?* The second research question was targeted

with two parts of the interview. First, teachers' explicit knowledge of RC strategies was examined by asking: *RC strategies are often mentioned in the reading literature—how do you understand the RC strategies?* Second, teachers' implicit knowledge of RC strategies was examined using these questions: *Please name activities that help people understand a text well. What activities are performed by good readers before, during, and after reading the text to understand a text well?* The third research question was examined by asking: *How do you help struggling readers? What kinds of tools and teaching techniques do you use?*

Procedure

A content analysis was employed to classify the qualitative data from interviews to quantitative data. This systematic process produced a numerical summary of the chosen message set. In addition, it "follows the standards of the scientific method (including attention to objectivity-intersubjectivity, a priori design, reliability, validity, generalizability, replicability, and hypothesis testing based on theory)" (Neuendorf, 2017, p.17). This is specified throughout the method.

Data collection was based on purposive sampling. Initially, we collected data from participants who were active classroom or special education teachers. After most of the data ($N=51$) were collected, we selected participants with a certain range of teaching experience to equalize the distribution of the lengths of teaching experience in the two groups. The data collection started in the spring of 2017 and ended in February 2020. Teachers' contact addresses were received from school web pages, their colleagues, or in-service courses.

All teachers were invited to voluntarily participate in the study. After receiving the informed consent, an interview was arranged. The teachers were not provided with questions in advance, so they could not specifically prepare for the interview. Most of the interviews were conducted by the first and second authors; about a quarter of the interviews were administered by a master's degree student in special education and a PhD student in psychology. The researchers followed the interview guide and conducted most of the interviews at the schools where the teachers worked; when that was not possible, they were conducted via Skype. With participants' approval, the interviews were recorded using a digital recorder. The confidentiality of teachers' responses was ensured. The data were anonymized and transcribed manually in their entirety.

Coding system

The construction of the coding scheme, which met undimensionality, mutual exclusiveness, exhaustiveness, and saturation requirements (Schreier, 2012), is presented in the codebook (see "Appendix"). It contained detailed procedures for coding each section of the interview, a detailed description and examples of each category, and step-by-step instructions for the coding process. The codebook was divided into four themes (i.e., RC processes, description of RC strategy definition, mentions of RC strategies, and RC instruction) to answer the three research questions (see Table 4).

Each theme had its own categories and subcategories (see Tables 5, 6, 7, 8). The preliminary subcategories were generated according to the data after reading through ¾ of the interviews. Then, the main categories were merged from data driven subcategories and theory. In addition, teachers' answers not related to the research questions were added to the category "other characteristics." After coding all the interviews, the "other characteristics" category was reviewed and coded again, as necessary.

Using the qualitative software NVivo 11, we initiated the coding process by reading for one of the four themes in all interviews. During reading the segmentation and coding were done simultaneously and manually using the coding form that was generated according to the codebook. A thematic criterion was used for segmentation (Schreier, 2012). After coding one theme, all coding material was revised and, if needed, coding corrections were made.

Two coders conducted pilot coding using four interviews. They practiced coding independently and then discussed the codings until they reached 100% agreement. The authors subsequently revised, evaluated, and modified the coding scheme according to the data. After the first author coded one third of the interviews, the coding scheme was modified again. A third coder was also trained, which meant practicing coding and engaging in a consensus-building discussion with the first author. All decisions on coding scheme were made before the final measurement process began, according to the a priori design. Ultimately, the first and third coders carried out the final coding ($n=50$ and 15, respectively) with the final coding scheme. Final intercoder reliability was assessed using randomly selected cases—overall, 11% ($n=7$) of the cases. The Cohen's kappa (κ) was used to calculate intercoder reliability for all subcategories in NVivo. The average results according to four main themes revealed substantial rater agreement in RC processes ($\kappa=0.67$), mention of reading strategies ($\kappa=0.78$), and RC instruction ($\kappa=0.67$), and almost perfect rater agreement in description of RC strategy definition ($\kappa=0.85$; Landis & Koch, 1977).

After coding, the matrix coding query was conducted in NVivo to describe how many times teachers mentioned the categories. This matrix was transferred into Statistical Software Package (SPSS) as individual variables, and the frequencies were replaced with 1 (present) or 0 (not present) for each participant. Teachers' background information was also added to the matrix.

Statistical analyses

Once the coding process was complete, frequency analyses were conducted to report the overall observed frequency in each category and between the groups of professional background. A chi-square test of independence was performed to examine the associations between mentioning different categories and professional background. Fishers' exact test was performed if the chi-square test requirements about the sample size or the number of observed variables were not met. Cramer's V coefficient was reported for these analyses to indicate the strength of the associations among the variables of interest. The coefficient varied between 0 (little association) and 1 (strong association).

A non-parametric Mann–Whitney U test was used to determine the differences in the number of mentioned reading strategies between classroom and special education teachers. To calculate the effect size for the Mann–Whitney U test, the probability-based measure *A*, a nonparametric generalization of the common language effect size statistic, was used. The statistic *A* is described as the probability that a randomly chosen member of Group 1 scores higher than a randomly chosen member of Group 2 based on the dependent variable (Ruscio, 2008). The *A* value ranges from 0.5 (the lowest probability) to 1.0 (the highest probability). All statistical tests were conducted at an alpha level of 0.05.

Results

Teachers' content knowledge about reading comprehension processes

The content analysis of teachers' responses related to crucial skills and processes for good text comprehension were sorted into five main categories: cognition, metacognition, background knowledge, reading motivation, and instructional components. Table 1 presents the frequencies of responses for each category and subcategory for all participants as well as groups from different professional backgrounds. The majority of teachers' responses fell in the cognition category. Reading fluency and linguistic awareness (e.g., vocabulary, syntactic knowledge, and grammatical skills), subcategories of cognition, were both mentioned by more than half of the teachers. General cognitive skills were mentioned by one third of the teachers. Most common answers were that "children must be able to concentrate" and "focus on reading."

Table 1 Frequencies of responses for each category with respect to skills and processes regarded as crucial for good text comprehension

Name of the category	Whole group ($N=65$)	General education ($n=28$)	Special education ($n=37$)
	N (%)	*n* (%)	*n* (%)
Cognition	56 (86.2)	24 (85.7)	32 (86.5)
Reading fluency and accuracy	43 (66.2)	17 (60.7)	26 (70.3)
Linguistic awareness	39 (60.0)	17 (60.7)	22 (59.5)
General cognitive skills	20 (30.8)	7 (25.0)	13 (35.1)
Metacognition (use of reading strategies)	22 (33.8)	7 (25.0)	15 (40.5)
Reading motivation	15 (23.1)	7 (25.0)	8 (21.6)
Background knowledge	13 (20.0)	*2 (7.1)*	*11 (29.7)*
Instructional components	26 (40.0)	12 (42.9)	14 (37.8)
Teaching activities at school	13 (29.2)	9 (32.1)	10 (27.0)
Adapted texts and tasks	12 (18.5)	5 (17.9)	7 (18.9)
Teaching activities at home	4 (6.2)	2 (7.1)	2 (5.4)

The significantly different results are in italics

Teachers also emphasized that "good memory is needed for remembering what I have read." "Logical thinking" and "analytical skills" were also mentioned several times. Only one third of the participants mentioned metacognition (i.e., use of reading strategies), such as "the ability to clarify the words," "identify the main idea and hidden links," "distinguish important and unimportant things," and "organize and think about what I have already read." Fewer participants mentioned readers' background knowledge and reading motivation. Finally, almost half of the teachers mentioned different instructional components at school or at home that were crucial for good text comprehension—that is, representing teachers' pedagogical knowledge rather than content knowledge; examples included "choosing age-appropriate text," "considering sentence structure, illustrations and font size," "reading compulsory books at home," "practicing reading together with a child," and "asking questions about the text."

Additional analyses were conducted to examine associations between teachers' knowledge and their professional background. A chi-square test of independence revealed a significant association between mentioning background knowledge and teachers' professional background, $\chi^2(1) = 5.08$, $p = 0.024$, $V = 0.28$. Special education teachers were more likely than classroom teachers to mention the reader's background knowledge as an important factor in RC. The proportion of participants providing responses in other categories did not differ by professional background ($p > 0.20$ in all cases).

Teachers' content knowledge of reading comprehension strategies

Teachers' explicit knowledge of RC strategies was examined through the description of the construct of RC strategies. The evidence of three aspects was assessed from teachers' answers: (1) reading strategy as mental or metacognitive activity; (2) process done by the reader or during the reading; and (3) the aim of the strategies (e.g., to acquire, organize, and elaborate information as well as reflect on and monitor readers' own text comprehension or simply improve some aspect of comprehension). Teachers' responses were divided into five main categories: (1) expected answer with evidence from all three aspects, (2) partly expected answer with evidence from one or two aspects, (3) mention of concrete activities or strategies, (4) missing answer, and (5) unexpected answer. None of the teachers mentioned all three aspects, and the answers of only 11 (17%) teachers were partly expected. For example, a common response was "strategies that children use to understand the text," while "strategy used by a person or me as a grown-up reader" (both categorized as partly expected answer) was rarely mentioned. Five participants (8%) mentioned particular reading strategies, such as "according to the heading, children should predict what this story is about," "reading diagonally," and "searching and remembering important parts of the text," or activities related to reading strategies in the classroom, such as "we are finding something from the text, we are underlining something." Almost one third of teachers (18, 28%) admitted that they were not able to describe what RC strategies are. In addition, almost half (31, 48%) gave unexpected answers (e.g., teachers expressed the view that comprehension strategies

were the same as teaching strategies or reading literacy). No significant association was found between teachers' explicit knowledge of RC strategies and their professional background ($p = 0.939$) according to Fisher's exact test.

We then examined teachers' implicit knowledge of RC strategies by asking them to name activities performed by a good reader to understand a text well. Table 2 presents the frequencies of responses for each category and subcategory of the entire group of participants and for groups from different professional backgrounds. A content analysis of teachers' responses revealed 16 different reading strategies. These strategies represented one of the four types of strategic processing: memorizing, elaborating, organizing, and monitoring.

Additional analyses were conducted to examine associations between teachers' knowledge and their professional background. A chi-square test of independence revealed a significant association between professional background and the mention of specific reading strategies, such as previewing, predicting, identifying the main idea, and evaluating the text. Special education teachers were more likely than classroom teachers to mention previewing [$\chi^2(1) = 8.192$, $p = 0.004$, $V = 0.36$], predicting [$\chi^2(1) = 10.049$, $p = 0.002$, $V = 0.40$], and identifying the main idea [$\chi^2(1) = 5.082$,

Table 2 Frequencies of reading comprehension strategies mentioned by teachers

Name of the category	Whole group ($N = 65$)	General education ($n = 28$)	Special education ($n = 37$)
	N (%)	*n* (%)	*n* (%)
Elaboration			
Previewing text	27 (41.5)	*6 (21.4)*	*21 (56.8)*
Predicting	26 (40.0)	*5 (17.9)*	*21 (56.8)*
Activating prior knowledge	21 (32.3)	7 (25.0)	14 (37.8)
Making connections	20 (30.8)	6 (21.4)	14 (37.8)
Making inferences	17 (26.2)	4 (14.3)	13 (35.1)
Identifying the main idea	13 (20.0)	*2 (7.1)*	*11 (29.7)*
Monitoring			
Clarifying	33 (50.8)	15 (53.6)	18 (48.6)
Observing one's understanding	33 (50.8)	14 (50.0)	19 (51.4)
Evaluating the text	23 (35.4)	*14 (50.0)*	*9 (24.3)*
Target reading	23 (35.4)	9 (32.1)	14 (37.8)
Questioning	15 (23.1)	5 (17.9)	10 (27.0)
Setting purposes	11 (16.9)	3 (10.7)	8 (21.6)
Memorization			
Remembering	24 (36.9)	8 (28.6)	16 (43.2)
Retelling	15 (23.1)	8 (28.6)	7 (18.9)
Organization			
Summarizing	26 (40.0)	8 (28.6)	18 (48.6)
Visualizing	16 (24.6)	6 (21.4)	10 (27.0)

The significantly different results are in italics

$p = 0.024$, $V = 0.28$] whereas classroom teachers were more likely to mention evaluating the text [$\chi^2(1) = 4.596$, $p = 0.032$, $V = 0.27$].

Finally, we analyzed the total number of reading strategies a teacher mentioned. The variability in the number of mentioned reading strategies was wide (Min = 1, Max = 11), the median number being 5. Figure 1 illustrates the frequencies of the strategies mentioned by classroom and special education teachers. A Mann–Whitney U test indicated that the number of mentioned reading strategies was significantly larger among special education teachers (*Mean rank* = 39.12) than classroom teachers (*Mean rank* = 24.91), z = − 3.037, $p = 0.002$, $A = 0.719$.

Teachers' pedagogical knowledge of reading comprehension instruction

A content analysis of the teachers' responses describing support for struggling readers sorted their answers into four main categories—namely, activities that support (1) reading fluency, (2) RC, (3) reading motivation, and (4) choosing and adapting texts and tasks. Table 3 presents the frequencies of responses for each category for all participants and for groups with different professional backgrounds. As indicated, the most frequently mentioned category (77% of the teachers) was related to activities to support reading fluency and accuracy. Teachers mostly mentioned "practicing reading together and correcting words with errors," "practicing a lot," "dividing words into parts and reading difficult words before reading a text," and "using bookmarks." Only half of the teachers mentioned activities to support RC, such as teaching RC strategies (e.g., "activating students' prior knowledge," "clarifying words together") and developing linguistic awareness (e.g., "combining parts

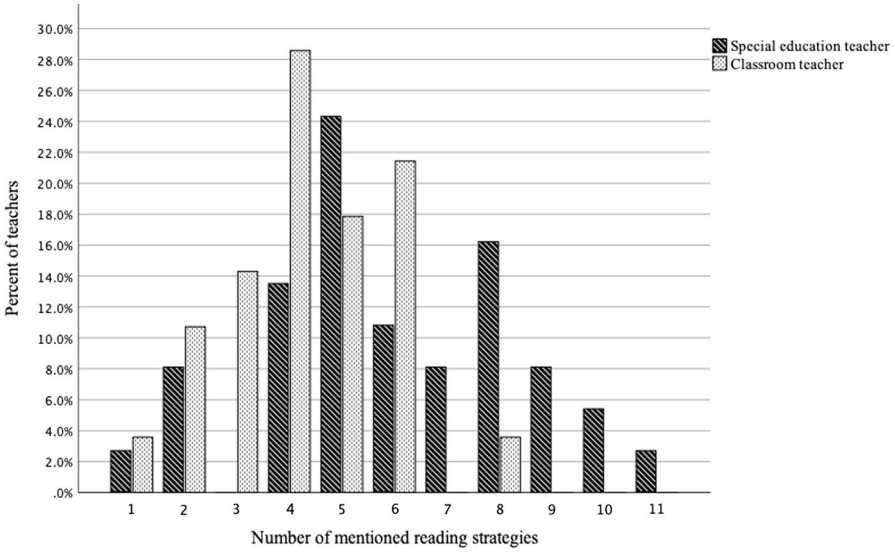

Fig. 1 Frequencies of the numbers of mentioned reading strategies by classroom and special education teachers

Table 3 Frequency of response for each category for description of helping struggling readers

Categories of comprehension instruction	Whole group ($N=65$)	General education ($n=28$)	Special education ($n=37$)
	N (%)	*n* (%)	*n* (%)
Activities to support reading fluency and accuracy	50 (76.9)	19 (67.9)	31 (83.8)
Activities to support reading motivation	37 (56.9)	*22 (78.6)*	*15 (40.5)*
Activities to support RC	34 (52.3)	*10 (35.7)*	*24 (64.9)*
Choosing and adapting texts and tasks	27 (41.5)	10 (35.7)	17 (45.9)

The significantly different results are in italic

of the sentences," "making sentences with new words"). More than half of teachers mentioned activities to support reading motivation while approximately 40% mentioned choosing and/or adapting texts and tasks to correspond to readers' challenges.

Additional analyses were conducted to examine the associations between teachers' knowledge and their professional background. A chi-square test of independence revealed a significant association between professional background and mentioning activities to support RC [$\chi^2(1)=5.429$, $p=0.020$, $V=0.29$]: Special education teachers were more likely than classroom teachers to mention activities to support RC. In addition, the association between professional background and mentioning activities to support reading motivation was significant [$\chi^2(1)=9.401$, $p=0.002$, $V=0.38$]: Classroom teachers were more likely than special education teachers to mention these. The proportion of participants providing responses in other categories did not differ by professional background ($p>0.10$ in all cases).

Discussion

In this study we examined teachers' knowledge of RC processes and instruction. The results showed that teachers' knowledge varied considerably but was mostly limited. In addition, teachers generally expressed a lack of explicit knowledge about the construct of RC strategies.

Teachers' content knowledge of reading comprehension processes

When describing skills and processes regarded as crucial for good text comprehension, more than half of teachers mentioned reading fluency and linguistic awareness (e.g., vocabulary, syntactic knowledge, and grammatical skills). This finding reflects the model of the Simple View of Reading (Gough & Tunmer, 1986), which considers comprehension as a product of decoding and linguistic comprehension. Mentioning reading fluency and accuracy indicated teachers' knowledge that decoding and reading fluency are strong predictors of RC in the early phase of reading development, as previous studies have found (Kendeou et al., 2009; Lerkkanen et al., 2004). In addition, the components of linguistic awareness are important predictors of RC

during the first years of schooling, particularly for readers of transparent orthographies (e.g., Estonian; for an overview, see Florit & Cain, 2011).

Previous research has shown that, after children's decoding skills become more automatized, higher-level skills (e.g., inference making skills and comprehension monitoring) are more important predictors of RC (Kendeou et al., 2014). However, teachers in our study rarely mentioned the use of reading strategies or techniques that help readers improve their ability to comprehend text (Gersten et al., 2001; Lee & Tsai, 2017). This finding is in line with previous studies indicating that reading strategies are not widely known among teachers (Anmarkrud & Bråten, 2012; Barron et al., 2018; Sampson et al., 2013). In addition, only one fifth of the teachers mentioned reading motivation and readers' background knowledge, which are also important in constructing the situation model (Kintsch, 2013). During this effortful process, readers need motivation that influences their RC directly, as well as through their metacognitive knowledge of reading strategies (van Kraayenoord et al., 2012). Furthermore, we found that special education teachers were more likely than classroom teachers to mention the reader's background knowledge as an important factor in RC. This finding indicates that a number of classroom teachers are not aware of the problems and limitations that struggling readers and poor comprehenders have with working memory capacity and background knowledge. However, activating or building background knowledge improves RC (Duke et al., 2011). It can be assumed that special education teachers' university training and daily work have provided them somewhat better knowledge.

Although interview questions sought to examine teachers' content knowledge, their answers also reflected their pedagogical knowledge. Almost half of the teachers mentioned different instructional components (e.g., teaching activities at school or at home, adapting texts and tasks) regarded as crucial for good text comprehension when asked about learner characteristics. The similar result that teachers interpret their answers through teaching activities instead of mentioning readers' mental activities has been found before (Sampson et al., 2013). If teachers are not clearly aware of cognitive and metacognitive processes that they are supporting with their teaching activities, they are likely not able to monitor students' development sufficiently and make changes in their own teaching activities.

Teachers' content knowledge of reading comprehension strategies

Teachers generally expressed a lack of explicit knowledge about the construct of RC strategies. They also indicated misconceptions about RC strategies, as previous studies found (Anmarkrud & Bråten, 2012; Sampson et al., 2013). A possible explanation for this result might be that teachers might have the knowledge, but are not explicitly aware of this construct, as the follow-up questions about teachers' implicit knowledge exposed that all teachers were able to mention at least some reading strategies. Altogether, 16 different reading strategies were mentioned. However, the number of reading strategies mentioned varied widely between participants, from one strategy to 11 strategies. These results are in line with classroom observation studies that revealed teachers use quite a narrow repertoire of strategies (Anmarkrud

& Bråten, 2012; Barron et al., 2018). In addition, we found that special education teachers mentioned a significantly greater number of reading strategies than classroom teachers. Again, special education teachers' training might have provided them with better knowledge in this area. Furthermore, students' RC difficulties may have directed special education teachers to find methodical solutions to support their development.

The associations that we found between teachers' professional background and mention of specific reading strategies suggest that special education teachers are more familiar with reading strategies used before reading than classroom teachers. This result concurs with our result for the first research question, where special education teachers were more likely to mention the reader's background knowledge as an important factor in RC, because reading strategies used before reading are mostly used to activate readers' prior knowledge.

Teachers' pedagogical knowledge of reading comprehension instruction

When describing additional support for struggling readers, the teachers most often mentioned activities supporting reading fluency. This result is in line with the findings of our first research question, where more than half of the teachers mentioned that reading fluency was crucial for good text comprehension. These findings may be explained by our sample and their teaching contexts, as classroom teachers' focus is on teaching decoding and reading fluency (Eesti Vabariigi Valitsus, 2020). These lower-level skills should be acquired in order to focus on RC (Perfetti & Stafura, 2014). However, our finding that only half of the teachers mentioned activities to support RC (e.g., developing linguistic awareness, teaching RC strategies) is concerning. Previous research has emphasized the importance of consistency in reading strategy instruction (Andreassen & Bråten, 2011; Houtveen & Van De Grift, 2007). Moreover, in languages with transparent orthography (e.g., Estonian), RC instruction should start already in the first grades (Lerkkanen et al., 2004; Soodla et al., 2015). However, our results support recent findings that teachers lack knowledge about RC instruction (Anmarkrud & Bråten, 2012; Barron et al., 2018). A possible explanation for this might be the demanding nature of explicit strategy instruction (Duke & Pearson, 2002). Additionally, difficulties in reading fluency are more evident for teachers than RC difficulties. It can therefore be assumed that surveyed teachers focused more on supporting lower-level RC skills, such as reading fluency and accuracy, and less on higher-level RC skills. The result may be also explained by teachers' beliefs that RC is a result of students reading experience, instead of a cognitive process requiring explicit instruction (Taboada & Buehl, 2012), indicating that limitations in teachers' pedagogical knowledge may be related to a lack of their content knowledge about RC.

The majority of teachers mentioned activities to support reading motivation, such as "generating interest," "giving students an opportunity to choose what part to read," "encouraging and providing students individual support," "giving a positive experience," and "assessing students based on their own development." This result supports previous research that confirmed the positive effect of supporting

students' reading motivation to their RC (Guthrie et al., 2007). Surprisingly, in our study, activities supporting reading motivation were mentioned more often than those supporting RC. However, previous studies have suggested giving priority to supporting basic skills that, in turn, support students' motivation to read (Guthrie et al., 2007; van Bergen et al., 2020). We found that special education teachers were more likely to mention activities to support RC whereas classroom teachers were more likely to mention activities to support reading motivation. These associations may partly be explained by their teaching context. Hence, further studies should explore whether classroom teachers make more effort to support the global quality of the classroom learning environment and special education teachers consider students' individual needs and skills that indirectly support reading motivation. Overall, RC can be improved by supporting reading motivation, but the main goal should be supporting RC skills, such as teaching students to use RC strategies efficiently (Lee & Tsai, 2017). In addition, better metacognitive knowledge of RC strategies enhances reading motivation, leading to positive reading attitudes (Kolić-Vehovec et al., 2014). Teaching students with varying knowledge and skills requires teachers to use complex approaches. However, it can be assumed that a considerable proportion of teachers lack comprehensive and evidence-based knowledge about methods of RC instruction.

Limitations and conclusions

Some limitations of the study should be considered. First, the data do not reflect a nationally representative random sample because we targeted specific groups of participants with similar characteristics to compare groups with different qualifications and teaching experience. Additionally, our sample size was rather small. Second, data collection through interviews has some limitations. Despite using an interview guide, the interviewers' background knowledge and experiences, including previous interview experience, could have influenced the interviewing process. Furthermore, teachers may be more knowledgeable than they chose to speak about in the interview. Moreover, gaps in teachers' responses may indicate that they have not been explicitly aware of their RC instruction (Brevik, 2014). Hence, they may be unable to formulate their tacit knowledge and implicit practices explicitly. Third, although intercoder reliability was perfect in the description of the RC strategy definition, the other three themes revealed only substantial rater agreement. However, larger differences between the coders may be explained by the fact that segmenting text into coding units was done simultaneously along with coding.

In conclusion, despite recent research focusing on RC processes and effective RC instruction, our results showed that teachers still lack knowledge of RC and RC instruction. This result indicates the need to improve these topics in preservice and in-service teacher training to enhance their teaching skills to fulfill students' potential to enhance their RC skills, which are crucial for their academic success and professional careers. In the future, RC strategy interventions should include teacher training and teachers' implementation of the program in the classroom to improve and expand teachers' knowledge of RC processes and instruction.

Appendix

Codebook

The codebook is divided into four themes to answer the three research questions (see Table 4 for detailed research questions, themes, and interview questions). The coder should start coding by themes, which means that one theme from all interviews should be coded first, followed by a second theme, and so on. One coding theme consists of teachers' answers to the interview questions in this coding theme. The coding schemes for the four themes are presented in Tables 5, 6, 7, and 8.

Dividing teachers' answers into units such that each unit fits into one category of the coding frame is called segmentation. A thematic criterion is used in the segmentation process, which means that the coder's task is to look for changes of topic according to the coding frame. Topic changes signal the end of one unit and the beginning of another. One unit of coding could be a word, phrase, sentence, or paragraph that could be categorized as one (sub)category in the coding frame. Segmentation and coding are done simultaneously.

Rules for coding: (1) the teacher's answer should be coded completely; (2) each unit of coding should be assigned to at least one and no more than one subcategory in the coding frame; (3) if the category has subcategories, then the subcategory has to be coded instead of the main category; (4) interviewer questions are not coded unless a teacher's answer is not understood without the specifying question, then the question is also coded with the teacher's answer in the same unit; (4) if the teacher's answer is not related to the research question and/or cannot be coded to any category of this theme or the interviewer is asked to repeat or paraphrase the question, then it should be added to the category of "other characteristics"; and (5) after coding one theme, all coded material should be revised and, if needed, corrections should be made.

Table 4 Links among research questions, interview questions, and coding themes

Research question	Coding theme	Interview questions
What knowledge do teachers possess about reading comprehension processes and how is their knowledge related to their professional background?	Reading comprehension process	What do you think is important for good text comprehension? Are there any other factors that are important for good text comprehension?
What knowledge do teachers possess about reading comprehension strategies and how is their knowledge related to their professional background?	Description of reading comprehension strategy definition	Reading comprehension strategies are often mentioned in the reading literature—how do you understand the reading comprehension strategies?
	Mentioning reading comprehension strategies	Please name activities that help people understand a text well. What activities are performed by good readers before, during, and after reading the text to understand a text well?
What knowledge do teachers possess about reading comprehension instruction and how is their knowledge related to their professional background?	Reading comprehension instruction	How do you help struggling readers? What kinds of tools and teaching techniques do you use?

Table 5 Coding scheme for reading comprehension processes

Category and subcategory	Description	Examples
Cognition		
Reading fluency and accuracy	Described factors that could be categorized as reading fluency and accuracy	Reading fluency, and accuracy, not making mistakes or correcting their mistakes
Linguistic awareness	Described factors that could be categorized as vocabulary knowledge, syntactic knowledge or grammatical skills	Understanding and using diverse vocabulary; having syntactic knowledge and grammatical skills to understand the words, sentences, and text structures
General cognitive skills	Described factors that could be categorized as general cognitive skills	Concentrating and focusing on tasks, considering attention allocation, working memory capacity, and logical thinking capabilities
Metacognition	Described factors that could be categorized as use or knowledge about reading strategies	Knowledge about reading strategies, using diverse reading strategies. Mentioning exact reading strategies (e.g., clarifying words, predicting, previewing text, making inferences, summarizing, questioning)
Background knowledge	Described factors that could be categorized as background or prior knowledge	Having background knowledge, having prior knowledge
Reading motivation	Described factors that could be categorized as reading motivation	Having reading interest, reading with enjoyment, reading with free will, thinking that reading is important, knowing and setting the purpose of reading, getting supportive and constructive feedback
Instructional components		
Teaching activities at school	Described factors that could be categorized as teaching activities at school	Teaching activities and practicing in the classroom, activities and additional support selected by the teacher (except adapting texts and tasks); teacher is asking questions about the text; practicing reading at school
Adapted texts and tasks	Described factors that could be categorized as adapting texts and tasks	Adapting (content, format, linguistic) and selecting appropriate texts and tasks according to students' needs
Teaching activities at home	Described factors that could be categorized as teaching activities at home	Teaching activities and practicing at home, including doing homework, practicing reading at home
Other characteristics	Answers not related to other categories in this theme	Explaining some factor, activity, or experience not related to this interview question

Table 6 Coding scheme for the description of reading comprehension strategy definition

Category and subcategory	Description	Examples
Expected answer	Expected answer with evidence from all three aspects: (1) reading strategy as the mental or metacognitive activity; (2) process done by the reader or during the reading; and (3) the aim of the strategies	(1) Mental activity, intellectual activity, (meta)cognitive activity; (2) activity by readers and/or that is done during reading; (3) efforts to improve some aspect of comprehension; to acquire, organize, and elaborate information; to reflect on and monitor readers' own text comprehension
Partly expected answer	Partly expected answer with evidence from one or two aspects of expected answer (see the expected answer description)	See the examples of the expected answer
Mentioning concrete activities or reading strategies	Mentioning reading strategies or activities that are related to them	Activating students' prior knowledge, searching for important parts, clarifying words, predicting, previewing text, making connections, making inferences, evaluating the text, summarizing, visualizing, questioning, setting purposes, remembering, identifying the main idea, monitoring, setting purposes
Missing answer	Admitting that the teacher is not able to describe the reading strategies	I don't know. I'm not aware of these
Unexpected answer	Answers that do not contain evidence from the three aspects of the expected answer and do not mention concrete reading strategies	Expressing the view that RC strategies are the same as teaching strategies or reading literacy
Other characteristics	Answers not related to other categories in this theme	Explaining some activity or experience not related to this interview question

Table 7 Coding scheme for mentioning reading comprehension strategies

Category and subcategory	Description	Examples
Elaboration		
Previewing text	Described activities that could be categorized as previewing text	Previewing the reading task to establish the goals and purposes for reading, previewing text to get information about the structure and length of it, previewing to clarify the location of searchable or important information
Predicting	Described activities that could be categorized as predicting	Predicting what might come next in the text; it could be done before reading a text or before the next paragraph; controlling prediction after reading (if right)
Activating prior knowledge	Described activities that could be categorized as activating or building prior knowledge	Thinking and talking about what we already know about this theme, finding additional information, and building background knowledge
Making connections	Described activities that could be categorized as making connections	Making connections among different pieces of the text (parts of the text, sentences, words)
Making inferences	Described activities that could be categorized as making inferences	Making inferences; integrating information from the text with prior or general knowledge; making connections among different pieces of the text and prior or general knowledge
Identifying the main idea	Described activities that could be categorized as identifying the main idea	Identifying the main idea of the text
Memorization		
Remembering	Described activities that could be categorized as remembering (parts of) the text or finding the important parts of the text	Marking important parts of the text to remember them, making notes
Retelling	Described activities that could be categorized as retelling	Repeating or paraphrasing the text or parts of it. If demonstrating only the main ideas, it should be categorized as summarizing
Monitoring		
Clarifying	Described activities that could be categorized as clarifying words, phrases, or sentences	Clarifying word meanings and confusing text passages, finding the difficult words or parts of the text, and clarifying their meaning

Table 7 (continued)

Category and subcategory	Description	Examples
Observing one's understanding	Described activities that could be categorized as observing one's understanding	Monitoring reading comprehension, observing one's understanding, selecting, and implementing reading strategies to look through and understand the text, thinking and talking about what has been understood or not understood
Evaluating the text	Described activities that could be categorized as evaluating the text	Making judgments, evaluating the text, giving their opinion about the text
Target reading	Described activities that could be categorized as target reading	Making pauses during reading, repeated reading or reading some parts of the text again, reading diagonally through the text
Questioning	Described activities that could be categorized as questioning	Reader creates questions about the text, generating one's own questions
Setting purposes	Described activities that could be categorized as setting purposes	Setting reading purposes
Organization		
Summarizing	Described activities that could be categorized as summarizing the text	Summarizing important parts of the text, demonstrating the main ideas of each paragraph
Visualizing	Described activities that could be categorized as visualizing the text	Creating mental pictures, visualizing, using graphic organizers
Other characteristics	Answers not related to other categories in this theme	Explaining some activity or experience not related to this interview question

Table 8 Coding scheme for reading comprehension instruction

Category and subcategory	Description	Examples
Activities to support reading fluency and accuracy	Described activities that could be categorized as supporting reading fluency and accuracy	Practicing reading in different ways (e.g., in pairs, in choir, in silent or outload, to teacher or friend or sibling); repeatedly reading; detecting and correcting words with errors; reading difficult words before reading the text; decomposing difficult words and using supportive signs in text for that; using bookmarks
Activities to support reading motivation	Described activities that could be categorized as supporting reading motivation	Supporting self-efficacy (e.g., giving students positive experiences showing they are capable of performing different tasks, giving constructive and supportive feedback); supporting reading interest (e.g., considering topics in students' interests, using different and interesting activities and tools); supporting the importance of reading; integrating different subjects and connecting new knowledge and practice; using external motivators (e.g., giving interesting tasks, giving awards, using competitions); ensuring a safe classroom environment physically and emotionally
Activities to support reading comprehension	Described activities that could be categorized as supporting reading comprehension: (1) teaching reading strategies; (2) developing linguistic awareness	(1) Activating students' prior knowledge, searching for important parts, clarifying words, predicting, previewing text, making connections, making inferences, evaluating the text, summarizing, visualizing, questioning, setting purposes, remembering, identifying the main idea, monitoring, setting purposes; (2) supporting vocabulary, syntactic knowledge, and grammatical skills
Choosing and adapting texts and tasks	Described activities that could be categorized as choosing and adapting texts and tasks	Choosing appropriate text; adapting texts and tasks; adding background knowledge to text; removing unimportant information; reducing new information; presenting information in a logical order; emphasizing the important aspects; parsing the text; considering the length of the words, sentences, and text; avoiding complicated sentence constructions; considering the meaning of the words (abstract words, synonyms); considering the font, size, and other format aspects of the text; repeating and paraphrasing the tasks; considering the use of oral or written tasks
Other characteristics	Answers not related to other categories in this theme	Explaining some activity or experience not related to this interview question

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Code availability NVivo qualitative data analysis software; QSR International Pty Ltd. Version 11.4.3 for Mac, 2017.

Declarations

Conflict of interest The authors declare that they have no conflict of interest.

Consent to participate Informed consent was obtained from the teachers included in the study.

Consent for publication All authors give their consent for publication.

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