

## DEVELOPMENT OF ESTONIAN STUDENTS' READING SKILLS AND TYPES OF READING ERRORS: A DESCRIPTIVE STUDY IN A LANGUAGE WITH TRANSPARENT ORTHOGRAPHY

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**Abstract.** This study aimed to describe the development of reading fluency and accuracy of Estonian students throughout an academic year. The longitudinal study assessed the reading skills of 112 students two times: in the winter of their third grade and the winter of their fourth grade. Three reading subtasks were used: connected text, word list and pseudo-word list. We found that reading fluency and accuracy developed significantly during the academic year, but the differences in the results of weaker and more skilled students were large. The average level of accuracy in reading was very high, while the reading errors that emerged were predominantly qualitative. However, the proportion of quantitative reading errors increased significantly when reading pseudo-words.\*

**Keywords:** reading fluency, reading accuracy, reading errors, reading development, transparent orthography, Estonian language

### 1. Introduction

Skilled reading, especially reading comprehension, is the basis for the acquisition of academic education as well as for success later in life (Catts, Kamhi 2017). According to the Simple View of Reading, reading comprehension as the ultimate goal of reading depends on the reader's decoding skills and level of linguistic comprehension. Decoding skills are defined as the ability to read words quickly and accurately, while linguistic comprehension is the ability to understand oral language. (Gough, Tunmer 1986) If the reader decodes words quickly and correctly, the term *oral reading fluency* (ORF) is used to refer to the general ability to read connected text rapidly, accurately, and with appropriate prosody (Fuchs et al. 2001, Veenendaal

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et al. 2015). Fluent reading, in turn, gives the reader the opportunity to focus their attention on the more cognitively taxing task – namely, comprehension – rather than decoding the words (Eason et al. 2013, Perfetti 2007).

One ORF component, prosody, includes intonation to accompany phrasing and thus also contributes to comprehension (Kuhn et al. 2010), yet previous research has instead focused on two key indicators of decoding skills: accuracy and speed. Previous research has mainly focused on languages with deep orthography, especially English, but the number of meta-analyses (Florit, Cain 2011) and cross-linguistic studies (Katzir et al. 2012, Seymour et al. 2003) comparing reading acquisition in languages with deep and transparent orthographies is also growing. However, the development of reading speed and accuracy in languages with transparent orthography should be further explored in order to make broader generalizations about the development of students' fluent reading skills. In Estonian, a language with transparent orthography (Viise et al. 2011), the reading skills of first- and second-grade students have been studied (Soodla et al. 2015, 2019), but no systematic or more detailed information has been collected on further development. Such knowledge would add valuable information to the field of languages with transparent orthography in general as well as help fill the gap about how the specifics of Estonian can influence the development of reading skills. Thus, the present study aims to describe the development of reading fluency and accuracy of Estonian students throughout one academic year, moving from third grade to fourth grade. The second aim is to gather information about what reading mistakes students make to provide comprehensive overview of Estonian students' reading mistakes in these grades.

### 1.1. Nature and development of reading fluency

ORF is usually acquired in primary school (Fuchs, Fuchs 1999, Kuhn, Stahl 2003) and is a prerequisite for silent reading (Price et al. 2016), which is extremely necessary in the upper grades. However, research has described fluent reading as involving a number of language-related and cognitive processes (Fuchs et al. 2001, Pikulski, Chard 2005). Fuchs et al. (2001) found that reading smoothly requires the reader to be able to automatically translate letters into speech sounds, combine these sounds into a recognizable whole, automatically give lexical meaning to the whole, and create meaningful connections within and between sentences. Such complexity and coordination of several processes can cause difficulties for many students and hinder the development of reading fluency and, thus, reading comprehension.

The development of reading fluency has been described in more detail by Ehri (2005) and Frith (1986), whose views partly overlap. First, children begin to “read” based on some salient feature of the word without having complete knowledge of grapheme–phoneme correspondence (*pre-alphabetic* and *partial alphabetic* stage per Ehri, *logographic* stage per Frith). Next, readers begin to use grapheme–phoneme correspondence while reading (*full alphabetic* stage per Ehri, *alphabetical* stage per Frith). Finally, readers start using letter patterns as stored units to read words and no longer decode letter-by-letter; therefore, the reading speed increases significantly (*consolidated alphabetic* stage per Ehri, *morphological* stage per Frith). Participants in the present study should have achieved the general reading level equivalent to the last of these stages.

In this study, we focus on the two key indicators of ORF: accuracy and speed. Reading errors, or so-called miscues, are errors produced when reading aloud and provide information about the accuracy level (Smith et al. 2020). Miscues are mostly described as additions, omissions, transpositions, and repetitions of speech sounds or whole words while reading aloud (Leslie, Caldwell 2011). On the one hand, miscues can be caused by the failure of lower-level reading processes; for example, it might be difficult to automatically apply grapheme–phoneme correspondence, causing the reader to err when decoding words (Ehri 2005, Hudson et al. 2008). On the other hand, miscues can also be caused by failures in higher-level reading processes; for example, the reader predicts words based on their knowledge and the context of the text, but errs in prediction (Ehri 2005, Hudson et al. 2008, Pikulski, Chard 2005). However, predicting words based on context can lead to reading errors; at the same time, predicting increases the speed of reading, making it smoother (Klauda, Guthrie 2008).

The second indicator – reading speed – also depends on the reader’s level of decoding skills and their ability to predict words based on context. For example, frequent repetitions, which reduce reading speed, indicate that the reader is having difficulty decoding words (Yang 2021). Long, frequent, and intrusive pauses within and between word reading also slow down reading speed and indicate readers’ poor skills (Godde et al. 2020). Researchers have also found that less fluent readers make pauses in inappropriate places, such as inside a meaningful unit (Binder et al. 2013).

The development of reading skills is also influenced by orthographies of languages, which differ in their transparency (i.e., the degree of phoneme–grapheme correspondence). Previous studies have found that acquiring reading skills in languages with transparent orthography requires less effort than in languages with deep orthography (Seymour et al. 2003, van Daal, Wass 2017) whereas, in languages with transparent orthographies, reading speed is more of a concern than reading accuracy (Landerl, Wimmer 2008). Seymore et al. (2003) found that reading accuracy in languages with transparent orthography (e.g., German, Finnish) was very high already at the end of the first grade, reaching about 95%, whereas in languages with less transparent orthography (e.g., French, Danish) the accuracy of reading was about 80%; in English – the least transparent language – the accuracy rate was only 34%. Thus, in languages with transparent orthography, the focus should be more on monitoring the development of reading speed. However, despite the fact that the average reading accuracy rate is high, students with insufficient phonological skills may still make more reading errors, as this skill is the key to decoding (Perfetti 2007).

To get comprehensive information about the level of reading fluency as well as reading errors, different assessment tasks must be used. One of the widely used approaches to assessing reading fluency is to measure how many isolated words are read correctly in one minute (Good et al. 2001). Another way is to analyze and evaluate word reading speed and accuracy in passages (Fuchs et al. 2001). Reading isolated words mainly gives information about lower level skills, while reading passages also increases the importance of reading comprehension (Eason et al. 2013). Again, it should be noted that when reading meaningful individual words, but even more so when reading connected text, the reader may occasionally use word prediction and not decode words letter by letter (Ehri 2005, Perfetti 2007).

Nevertheless, as phonological skills, which allow the reading of both meaningful and non-meaningful words, are considered to be the key of word decoding (Muter et al. 2004, Perfetti 2007), pseudo-word reading is also used to assess students' skills (De Luca et al. 2002, Roch, Jarrold 2012).

To sum up, ORF develops stage by stage (Ehri 2005, Frith 1986) until reaching a level characterized by a low number of reading errors (Laing 2002) and few repetitions and inappropriate pauses (Binder et al. 2013, Yang 2021). However, each language has its own specifics which can affect the development of reading fluency, which is why research in different languages is necessary. The present study examines Estonian, which has several specific features, but has thus far been under-studied.

## 1.2. Learning to read in Estonian

The Estonian language has transparent orthography (Viise et al. 2011); therefore, Estonian children learn to read rather fast. Most Estonian children who enter school can already read words and, by the end of first grade, reading accuracy is quite high (Soodla et al. 2015). The peculiarity of the Estonian orthography requires a distinction of sound length in three ways: short, long, and overlong (Karlep 2000, Lippus et al. 2009); the long and overlong sound lengths are, in most cases, marked similarly in the word print form (e.g., in the word *kallas*, where *l* is pronounced with a long sound length, means 'shore', but when pronounced with an overlong sound length, it means 'poured', like 'poured milk'). The exceptions are the speech sounds /p/, /k/, and /t/, which are usually denoted in word print form in three different ways: *b*, *g*, and *d* denote a short length; *p*, *k*, and *t* denote long length, and *pp*, *kk*, and *tt* denote overlong length. Karlep (1991) explained that, when reading, both a formal check (i.e., whether it has been read according to the word print form) and a semantic check (i.e., whether the meaning of the word is appropriate to the context of the sentence) must be performed. Reading errors due to the incorrect reading of speech sound lengths are called *quantitative errors* (Karlep 2000). The proportion of quantitative errors in reading is not known, but it has been found that quantitative errors in writing words make up the majority (Karlep 2000). The same study found that most quantitative errors were made in a high-risk place within the word – namely, at the border of the first and second syllables of the word (e.g., in the word *katus* 'roof', the speech sounds /at/ are located inside the high-risk place; students often learn that a high-risk place begins before the first vowel or diphthong and ends before the next vowel or diphthong).

Estonian language has an agglutinative morphology, where new word forms are obtained mainly by adding morphemes to the word stem (Hint 1998, 2004). Therefore, long word forms, which often contain many suffixes and/or prefixes, are typical of Estonian (Hint 1998, 2004). For less skilled readers, decoding long words can be difficult. When reading longer words, substitutions, omissions, and additions of speech sounds may occur more often; these errors are called *qualitative errors* in Estonian (Karlep 2000).

According to the National Curriculum for Basic Schools (Government of the Republic of Estonia, 2011), Estonian students should be able to read fluently by the end of the first school stage (i.e., third grade). The reading skills of Estonian

first- and second-grade students have already been studied (Soodla et al. 2019), but it is important to continue researching the development of reading skills in the third and fourth grades to assess whether and to what extent the requirements set in the curriculum are realized.

## **2. Present study**

The present study aims to describe the development of students' reading fluency and accuracy throughout one academic year. It also aims to provide an overview of students' main reading errors. The research seeks to answer three questions:

1. How has students' reading fluency and accuracy developed throughout one academic year?

Hypothesis 1. As several studies have shown that learning to read in languages with a transparent orthography requires less effort (Seymour et al. 2003, van Daal, Wass 2017), we assume that the majority of students have achieved a good general level of reading skills by the fourth grade, which meets the curriculum requirements (Government of the Republic of Estonia 2011).

Hypothesis 2. As the average accuracy rate of reading is high in languages with transparent orthography (Seymour et al. 2003, Soodla et al. 2015), we assume that the average reading accuracy is greater than 90% in this study as well.

2. How has the fluency and accuracy of students' reading at different skill levels (weak, average, and skilled readers) developed throughout one academic year?
3. What are the main types of reading errors?

## **3. Method**

### **3.1. Participants**

The present longitudinal study's sample initially included 187 third-grade students (11 different class sets) from nine different general education schools. A year later, in the fourth grade, it was possible to repeatedly assess 112 students (seven different class sets) from seven different schools. The main reason participants dropped out was the outbreak of the Covid-19 virus. Therefore, the present study analyzes and compares data collected from 112 students: 48 (42.9%) boys and 64 (57.1%) girls. The average age of students was 9.66 ( $SD = 0.28$ ) years in the third grade and 10.74 ( $SD = 0.31$ ) years in the fourth grade. The average class size was 21 students ( $SD = 4.62$ ).

### 3.2. Materials and procedure

In the third and fourth grades, the same test materials were used and the same principles were applied in terms of procedure and data coding and analysis. First, students read aloud a connected text, with a time limit of 60 seconds, and their reading was recorded. The connected text was selected from a children's book and it was about fishing. The text consisted of 32 sentences (a total of 197 words, of which 39 were longer words, i.e., consisted of more than six characters), the mean sentence length was 6 words. To assess students' general level of reading skills, we used experts' judgments. Experts listened to students' connected text readings and used a four-point scale to rate them:

- 4 = The student reads texts fluently (at the pace of normal speaking) and correctly;
- 3 = The student reads mostly fluently (at the pace of speaking), but is slower when reading long words, and reads mostly correctly;
- 2 = The pace of reading is slower than the pace of speaking, the student struggles with longer words, and the student sometimes makes mistakes when reading longer words;
- 1 = The rate of reading is slow, the student struggles with longer words, and the student often makes mistakes when reading words.

The descriptions of the scale points were compiled by the first and second authors of the article based on the national curriculum and previous knowledge about the development of reading among Estonian children (Karlep 1991, Viise et al. 2011) as well as the theories of reading development stages (Ehri 2005, Frith 1986). Initially, the two experts (the first author and a graduate-level student in special education) listened together to audio recordings of students' reading a connected text and discussed which scale rating would be most appropriate. After the training, the experts independently assessed the reading level of all students using a four-point scale. Finally, the first author once again listened to the recordings, for which the assessments differed, and gave a final assessment. Based on reading a connected text, a score was also given for the fluency of each student's reading. To give the score, the number of words the student read correctly in one minute was counted, and the student received one point for each correctly read word.

Second, students read a 90-item word list, with a time limit of 60 seconds. The structure of words became increasingly complex, ranging from one-syllable words to eight-syllable words containing diphthongs and/or consonant clusters. The words also became increasingly complex in meaning, starting with very familiar words (e.g., *ema* 'mother', *reede* 'Friday') and ending with less familiar words (e.g., *indiaanlane* 'Indian', *universum* 'universe'). The reading was recorded, and the number of words read correctly in one minute was used as a score.

Finally, students read a 90-item pseudo-word list, with a time limit of 60 seconds. Similar to the word list, the structure of pseudo-words also became increasingly complex, ranging from one-syllable words to five-syllable words containing diphthongs and/or consonant clusters. Most pseudo-words were created based on the words in the word list by replacing the two phonemes (e.g., the word *kringel* 'pretzel' was replaced by the pseudo-word *trängel*). The reading was recorded, and the number of pseudo-words read correctly was used as a score.

The reading tests were compiled by the second author. All tests were performed at the students' school on a single school day. Data were collected from third-grade students in November–December 2019 and from fourth-grade students in November 2020–January 2021.

### **3.3. Data coding and analysis**

To describe students' general reading level, three groups were formed based on the experts' final assessment: weak readers (scale assessments 1 and 2), average readers (scale assessment 3), and skilled readers (scale assessment 4). The consistency in experts' assessments was high in both grades and in each subgroup (Cohen's kappa range .75–.94).

To describe the fluency, including speed and accuracy, of students' reading, the number of correctly read words was counted in three reading tests. As strong correlations existed among the number of correctly read words in the three reading tasks (.77–.86), the results were summed to give the final score for each student. To describe the accuracy rate of students' reading, the percentage of each student's correctly read words in the total number of words read was calculated. As moderate to strong correlations occurred in the level of accuracy among the three subtasks (.44–.70), the results of the three tasks were summed to give the final score.

In addition, for the three subtasks, reading errors were coded in incorrectly read words. If the student used self-correction while reading, the error was not coded. The reading error coding system is presented in Table 1. A reading error coding system was developed in collaboration between the first and second authors of the article based on previous error descriptions (Karlep 2000). Reading error coding was initially practiced jointly, and then the first author continued. Finally, reading errors of 10% of the students were double-coded to ensure reliability. The Cohen's kappa between the two encoders was .97.

To assess the development of the general level of reading skills, the expert assessments in the third and fourth grades were compared. To assess the development of students' reading fluency, the mean score of correctly read words in the third and fourth grades was compared. To investigate the extent to which reading fluency rate developed in the reader subgroups (weak, average, skilled) identified in the third grade, we compared the results of the same students in both grades. To assess the development in reading accuracy, the mean scores of the proportions of correctly read words in the third and fourth grades were compared; to analyze the development of subgroups' reading accuracy, the same approach as in the fluency part was used. The paired sample *t*-test was used to assess statistical significances, and Cohen's *d* was used to assess the effect size. Finally, in order to provide an overview of the types of reading errors, we analyzed the proportions of reading error by reading subtasks.



**Table 1.** Categories and subgroups of reading errors

Reading errors		Example
<b>Qualitative errors</b>	phoneme deletion	the word <i>konks</i> 'hook', student read without /n/ <i>koks</i>
	phoneme addition	the word <i>kōrsikud</i> 'cookie sticks', student read by adding /k/ <i>kōrksikud</i>
	phoneme substitution	the word <i>kōrsikud</i> 'cookie sticks', student read by replacing /k/ with /t/ <i>tōrsikud</i>
	phoneme reordering	the word <i>konks</i> 'hook', student read by reordering /s/ and /k/ <i>konsk</i>
<b>Quantitative errors</b>	only vowel duration distortion in a high-risk place within a word (the high-risk place does not contain compounds) where the word stressed-rhythmical structure changed (type 1)	the word <i>seelik</i> 'skirt' where /e/ is long, student pronounced a short /e/ <i>selik</i>
	only non-plosive consonant duration distortion in a high-risk place within a word (the high-risk place does not contain compounds) where the word stress-rhythmical structure changed (type 2)	the word <i>lammas</i> 'sheep', where /m/ is long, student pronounced a short /m/ <i>lamas</i>
	only plosive consonants (p, k, t) duration distortion in a high-risk place within a word (the high-risk place does not contain compounds) where the word stress-rhythmical structure changed (type 3)	the word <i>ratas</i> 'wheel', where /t/ is long, the student pronounced a short /t/ <i>radas</i>
	distortion of the length of one or more sounds in a high-risk place within a word (the high-risk place may contain compounds), but the word stress-rhythmical structure remained the same (type 4)	the word <i>seelik</i> 'skirt', the student read <i>sellik</i> ; the word <i>linde</i> 'a lot of birds', the student read <i>linte</i>
	distortion of the length of one or more sounds in a high-risk place within a word (the high-risk place may contain compounds) where the word stress-rhythmical structure also changed (type 5)	the word <i>hundi</i> 'wolf_GEN', student read <i>hunti</i> 'wolf_PART'
	distortion of the length of one or more sounds outside the word's high-risk place (type 6)	the word <i>vanker</i> 'wagon', student read <i>vankeer</i>
<b>Word replacement*</b>		one full-meaning word replaced by another full-meaning word (e.g., the word <i>artistlik</i> 'artistic', student read <i>arstlik</i> 'medical')
<b>Distorted word</b>		words that are so distorted that error types cannot be determined or there are more than two errors in the word

\* This category was not used to determine the types of errors made when reading pseudo-words.



## 4. Results

To give an overview of the general level of students' reading skills and its development, the expert judgments were compared. The distribution of students in reading level subgroups is presented in Table 2. The results show that 53% of weak readers based on the expert assessment in the third grade moved into the average group, while slightly more than half of average readers moved to the skilled readers group. Nine students (8%) out of 112 were still considered weak readers in the fourth grade.

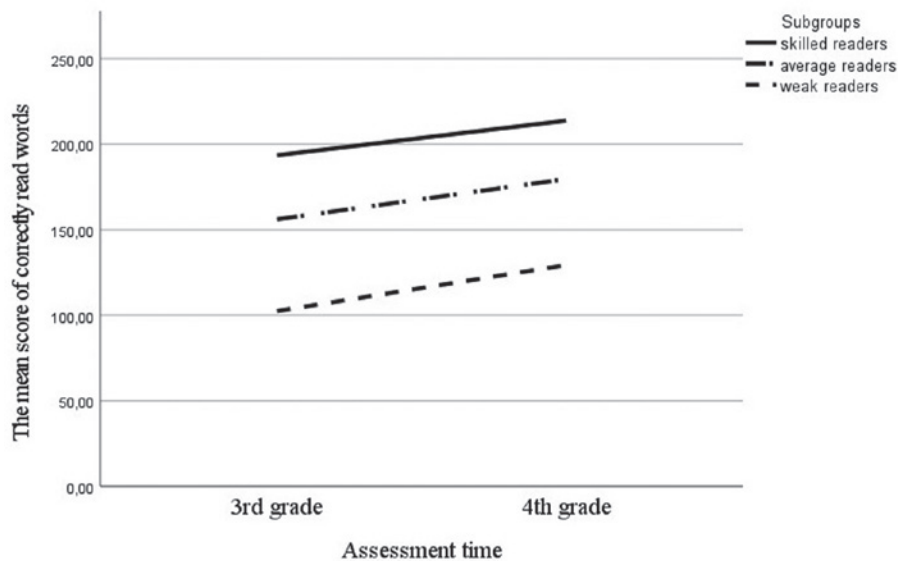
**Table 2.** Reading subgroup sizes in third and fourth grades (*n* – the number of students in the subgroup; % row percentage)

Expert judgments in 3rd grade		Expert judgments in 4th grade			Total ( <i>N</i> = 112)
		Weak Reader	Average Reader	Skilled Reader	
Weak reader	<i>n</i>	9	10	0	19
	%	47.4	52.6	0	100
Average reader	<i>n</i>	0	25	28	53
	%	0	47.2	52.8	100
Skilled reader	<i>n</i>	0	3	37	40
	%	0	7.5	92.5	100
Total ( <i>N</i> = 112)		9	38	65	112

Next we studied how the fluency score, including speed and accuracy, of students' reading changed over the academic year. Students' results statistically significantly improved in the whole sample and each subgroup (see Table 3; Figure 1). Despite the development of each subgroup, the results also showed that students' level of reading fluency can vary by up to four times; for example, the score of the weakest reader in third grade was 61 while the score of the most skilled reader in third grade was 235.

**Table 3.** Changes in reading fluency in third and fourth grades

Student groups	3rd grade		4th grade		<i>t</i> ( <i>df</i> )	<i>p</i>	Cohen's <i>d</i>
	<i>M</i> ( <i>Min-Max</i> )	<i>SD</i>	<i>M</i> ( <i>Min-Max</i> )	<i>SD</i>			
All students ( <i>N</i> = 112)	160.37 (61–235)	37.00	183.32 (78–257)	36.03	–18.06 (111)	<.001	.63
Weak reader ( <i>n</i> = 19)	102.47 (61–143)	17.86	129.37 (78–160)	19.09	–9.07 (18)	<.001	1.46
Average reader ( <i>n</i> = 53)	156.09 (119–220)	20.25	179.66 (140–219)	19.37	–14.19 (52)	<.001	1.19
Skilled reader ( <i>n</i> = 40)	193.53 (157–235)	20.48	213.80 (151–257)	25.22	–8.517 (39)	<.001	.88

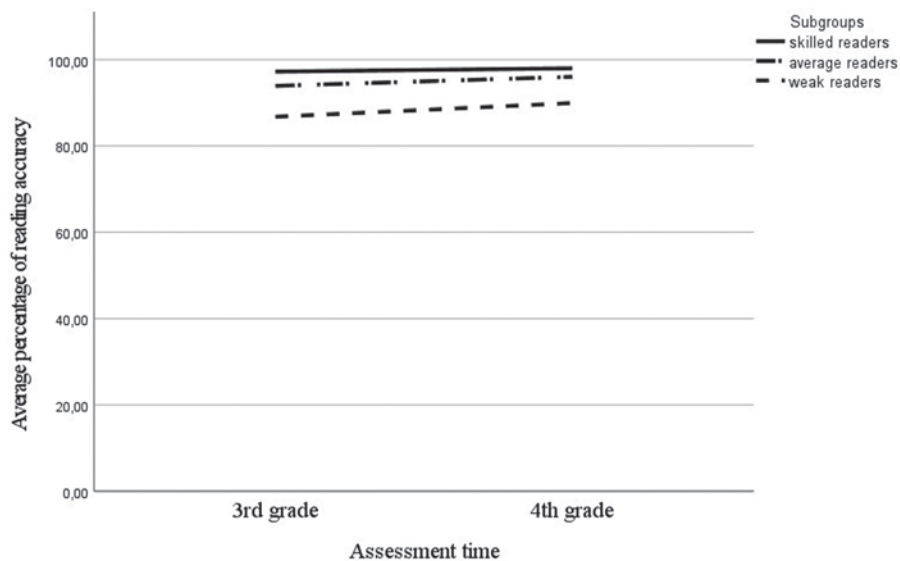


**Figure 1.** Development of reading fluency

To assess the development of students' reading accuracy, we compared the average scores of the proportion of correctly read words in both grades. Students' results improved significantly in the whole sample and each subgroup (see Table 4; Figure 2). Although the average level of accuracy of the whole sample was high in both the third (93.91) and fourth (95.72) grades, the minimum and maximum results differed substantially among students. Some readers read in both grades with 100% accuracy, while the accuracy rate of weaker readers remained at or even below 75%.

**Table 4.** Changes in reading accuracy in third and fourth grades

Student groups	3rd grade		4th grade		t (df)	p	Cohen's d
	M (Min–Max)	SD	M (Min–Max)	SD			
All students (N = 112)	93.91 (73.2–100)	5.46	95.72 (75.7–100)	4.05	-5.241 (111)	<.001	.38
Weak reader (n = 19)	86.78 (73.9–96.0)	6.33	89.96 (75.7–96.1)	4.77	-2.138 (18)	.023	.57
Average reader (n = 53)	93.94 (73.1–99.4)	4.45	96.05 (87.5–100)	2.91	-4.601 (52)	<.001	.56
Skilled reader (n = 40)	97.25 (90.6–100)	1.90	98.02 (91.6–100)	1.75	-3.698 (39)	<.001	.42



**Figure 2.** Development of reading accuracy

Next, we compared the percentages of reading errors. The proportion of reading errors (the total number of errors coded was 1114) in the third grade was distributed as follows: 59.1% qualitative errors, 28.5% quantitative errors, 9.1% word replacement errors, and 3.3% distorted word errors. The proportion of reading errors in the fourth grade (the total number of errors coded was 855) was quite similar: 66.0% qualitative errors, 21.8% quantitative errors, 9.7% word replacement errors, and 2.6% distorted word errors. We also wanted to know of any differences in the types of reading errors by reading subtasks. We focused on two main categories of errors – qualitative and quantitative errors – because they were most often represented; in addition, quantitative errors are specific to the Estonian language. The percentages of the errors are presented in Table 5.

**Table 5.** Proportions of qualitative and quantitative reading errors by subtasks

Reading errors	Grade	Subtasks		
		Connected text	Word list	Pseudo-word list
Total number of qualitative and quantitative errors	3rd	225	209	542
	4th	212	145	394
Qualitative errors	3rd	92.4%	69.4%	56.3%
	4th	92.0%	75.9%	65.0%
Quantitative errors	3rd	7.6%	30.6%	43.7%
	4th	8.0%	24.1%	35.0%

Finally, to get a more detailed overview of the distribution of different types of reading errors, we analyzed the proportions of reading errors for each reading subtask in both grades. The detailed data is summarized in the Table 6.

**Table 6.** Proportions of reading errors by subtasks

Reading errors	3rd grade			4th grade		
	Connected text	Word list	Pseudo-word list	Connected text	Word list	Pseudo-word list
<b>Total number of errors</b>	281	269	564	262	188	405
<b>Number of qualitative errors</b>	208	145	305	195	110	256
Phoneme deletion	42.8%	31.3%	18.0%	42.1%	40.0%	14.8%
Phoneme addition	28.8%	26.9%	27.5%	31.3%	29.1%	33.6%
Phoneme substitution	25.0%	31.7%	38.4%	23.1%	24.5%	39.8%
Phoneme reordering	3.4%	10.3%	16.1%	3.6%	6.4%	11.7%
<b>Number of quantitative errors</b>	17	64	237	17	35	138
Type 1	0%	29.7%	23.2%	5.9%	25.7%	21.7%
Type 2	5.9%	4.7%	6.8%	0%	5.7%	6.5%
Type 3	5.9%	25.0%	8.4%	5.9%	22.9%	8.0%
Type 4	52.9%	18.8%	50.3%	47.1%	22.9%	44.9%
Type 5	35.3%	9.4%	9.3%	35.3%	8.6%	15.2%
Type 6	0%	12.5%	1.7%	5.9%	14.3%	3.6%
<b>Number of distorted words</b>	5	10	22	2	9	11
<b>Number of word replacements</b>	51	50	0*	48	34	0*

\* This type of error was not coded in the PWL subtask; see the description of quantitative error types in Table 1.

## 5. Discussion

The aim of the study was to describe the development of students' reading fluency and accuracy throughout an academic year and provide an overview of the main reading error types. Although many students' general reading level improved during the study, some fourth-grade students' reading skills were still weak. However, the reading fluency and accuracy rate significantly increased in the weak, average, and skilled subgroups. At the same time, the results of the weakest and most skilled students differed substantially. In general, qualitative reading errors were predominant, but the number of quantitative errors also increased significantly when reading pseudo-words.

First, to describe the general development of students' reading fluency and accuracy, we used expert assessments. As expected, many students' reading skills

improved; about half of students moved from the weak subgroup to the average subgroup while half the average subgroup moved to the skilled subgroup of readers. These results are in line with previous studies' findings that learning to read in languages with transparent orthography requires less effort (Seymour et al. 2003, van Daal, Wass 2017). In the present study, the entire sample's average percentage of reading accuracy in both grades was close to 95%. Based on the results, both proposed hypotheses were confirmed. First, as expected, most fourth-grade students had acquired reading skills at a level that met the national curriculum requirements; second, the average level of reading accuracy was very high.

Nevertheless, despite students' general good level of reading skills, approximately 8% of fourth-grade students were still considered weak readers. Considering that Estonian schools usually have about 20–24 students in one class, it can be estimated that after primary school each class has about two students whose reading fluency level does not meet the curriculum's learning outcomes. Moreover, these students' ability to read silently is even more limited (Price et al. 2016), nor can they devote all their resources to reading comprehension due to their lower level of decoding skills (Eason et al. 2013, Perfetti 2007). These students desperately need additional support and guidance from teachers and support specialists. Unfortunately, several studies have found that teachers have difficulty assessing students' reading fluency, and students with lower reading skills tend to be overestimated (e.g., Feinberg, Shapiro 2009). This, in turn, can lead to students being deprived of timely and appropriate support. Even more, students who do not receive early intervention based on their individual level may have difficulties in reading throughout their academic studies (Juel, Leavell 1988).

Second, we wanted to know how the level of reading fluency and accuracy changed within subgroups of readers. We found that the average score of reading fluency and accuracy increased statistically significantly over one academic year in both the sample as a whole and each subgroup of readers. Although each subgroup's results significantly improved, there was extreme variability in the results of the weakest and most skilled students. For example, the reading fluency score of the weakest and most skilled third-grade students differed by almost four times. Such great variability may be due to the fact that, in languages with transparent orthography, reading speed may be a concern (Katzir et al. 2012, Landerl, Wimmer 2008), and in this study, the reading fluency indicator included both accuracy and speed. Thus, a student with a low fluency score could read correctly, but it took a long time due to insufficient decoding skills. As in previous studies (Seymour et al. 2003, Soodla et al. 2015, 2019), the average reading accuracy rate in our study was also very high. But comparing weaker and more skilled readers, we again found significant variability, starting with 100% accuracy and then falling even below 75%. Although the lower cognitive level of weaker students inhibits reading accuracy, the long-word forms which are typical of the Estonian language (Hint 1998, 2004) as well as the need to distinguish between the length of speech sounds while reading (Lippus et al. 2009) may increase the making of reading errors.

Despite the possible reasons for reading errors, these differences between students' reading skills suggest an important issue. How should educators choose texts which are appropriate and developing for the student? The accuracy rate of reading a text aloud should be about 95% for it to be considered suitable for developing both

reading fluency and reading comprehension (Saha et al. 2021). Moreover, this difficulty level allows reading to be a fun activity and thus increases students' motivation (Stanovich 2009). However, several students in our study demonstrated reading accuracy rate significantly below the recommended level, i.e., below 95%; thus, we might assume that the texts read daily at school may also be too complicated. This kind of variability in students' reading skills is a challenge for the teacher, who is responsible for the simultaneous development of weak readers as well as average and skilled readers. It is also crucial to emphasize that schoolbooks could include texts at different difficulty levels. As only teaching in the nearest area of development is effective and supports the realization of a student's full potential (Vygotsky 1978), teaching and supporting students at different levels in a way that is executable for them is the key to success.

Finally, we focused on the proportion of different types of reading errors. In general, qualitative errors dominated in both grades, followed by quantitative errors specific to Estonian. Going deeper and analyzing the types of errors by reading subtasks revealed that the proportion of quantitative errors increased when reading the word list, but even more significantly increased when reading pseudo-words. In such a situation, the context could help predict words and therefore avoid quantitative errors when reading connected text and meaningful words (Ehri 2005, Hudson et al. 2008, Perfetti 2007), especially in Estonian, where the word in print may be the same (Karlep 2000) but the pronunciation depends on the context. However, reading pseudo-words eliminates the possibility of predicting words, and reading performance depends directly on the reader's level of phonological and decoding skills (Muter et al. 2004, Perfetti 2007). Although our study identified many types of errors, we do not discuss them in detail herein, but the overview of the proportion of different types of errors in reading subtasks found in Table 6 can help teachers more consciously identify and map students' reading errors.

## **6. Limitations and conclusion**

This study has some limitations that should be considered when generalizing the findings. First, the development of students' reading skills might have been influenced by the coronavirus pandemic as schools relied on distance learning to a certain extent; therefore, reading practice may have been less intensive than it would otherwise have been. In addition, the relatively small sample should be considered a limitation of the study.

Despite the limitations, the study provides an overview of the general development of Estonian students' reading skills, including the development of fluency and accuracy. The results showed that the majority of students achieved a good level of reading skills. Nevertheless, the results also emphasize that students' reading levels can vary greatly, which poses challenges for teachers in choosing materials and involving all students in executable reading activities. It is certainly worth exploring further how well teachers themselves can notice weak readers as well as students' reading errors. Also, it would be worthwhile to describe in more detail the types of reading errors that readers at different levels of reading skills make.

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# EESTI ÕPILASTE LUGEMISOSKUSE ARENG NING LUGEMISVEAD: KIRJELDAV UURING TRANSPARENTSE ORTOGRAAFIAGA KEELES

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Uuringu eesmärk oli kirjeldada eesti õpilaste lugemise ladususe ja õigsuse arengut ühe õppeaasta vältel. Õpilaste lugemise ladususe ja õigsuse taset hinnati kahel korral: 3. ja 4. klassi talvel. Mõlemal korral kasutati hindamiseks kolme testi: sidusat teksti, sõnade loendit ja pseudosõnade loendit. Selgus, et õpilaste lugemise ladususe ja õigsuse arenesid ühe õppeaasta jooksul oluliselt. Enamik 4. klassi õpilasi luges ladusalt ja valdavalt ilma vigadeta, õigesti loeti keskmiselt umbes 95% sõnadest. Kuigi märgatavalt arenes ka nõrgemate lugemisoskustega õpilaste lugemise ladususe ja õigsuse, oli 4. klassis siiski umbes 8% õpilasi, kelle lugemistehnilist oskuste tase oli väga madal. Samuti selgus, et nõrgemate ja oskuslikumate lugejate lugemise ladususe ja õigsuse näitajad erinesid väga suurel määral. Lugemisvigadest moodustasid enamuse kvalitatiivsed vead, kuid kvantitatiivsete vigade osakaal tõusis märgatavalt pseudosõnade lugemisel. Kokkuvõttes viitavad uuringu tulemused mõnele olulisele kitsaskohale lugema õpetamise valdkonnas. Esiteks, neljandates klassides leidub mitmeid õpilasi, kelle lugemistehniliste oskuste tase ei vasta õppekavas seatud nõudmistele ning see omakorda võib raskendada nende toimetulekut teises kooliastmes. Teiseks, õpilaste lugemisoskuse suur varieeruvus seab väljakutseid õpetajale – kuidas valida lugemistekste, mis oma raskustasemelt oleksid õpilastele arendavad. Seejuures tuleb meeles pidada, et õpetaja ülesandeks on toetada nii nõrgemate, keskmiste kui ka oskuslike lugejate arengut.

**Võtmesõnad:** lugemise ladususe, lugemise õigsuse, lugemisvead, lugemise areng, transparentne ortograafia, eesti keel

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