Investigation of the Relationship between Phonological Decoding and Word Reading Speed and Accuracy in Developmental Perspective [*]

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Abstract

The main purpose of this research is to examine the relationship between phonological decoding skills and word reading fluency with a developmental perspective. A total of 300 students from the first, fourth, and eighth grades participated in the study. The phonological decoding skills were evaluated with the "Phonological Decoding and Evaluation Tool" and the word reading fluency was evaluated with reading texts at different grade levels. All assessments were carried out individually in an environment determined within the students' own schools. Data obtained from the study were analyzed by calculating the Mann-Whitney U test and the Pearson Correlation Coefficient. Findings show that there is a significant relationship between phonological decoding skills and word reading fluency subscales. Results were discussed on the basis of the reading performance of students participating in the study and the word decoding strategies they used during reading.

Introduction

One of the primary goals of the elementary school is teaching reading and writing. The problems encountered in reading skills that affect an individual's whole academic life are among the main reasons of academic failure (Justice, Invernizzi, Geller, Sullivan, & Welsch, 2005; Unalan, 2001).

The most general definition of reading, which is defined as the process of extracting meaning from written symbols, including all sub dimensions based on the operational processes, is that "the process in which the readers decode the words in written texts by appropriate orthographical, phonological, morphological knowledge and skills, followed by comprehension by associating the decoded words with existing vocabulary, previous knowledge and experiences, and then by analyzing and reaching the message from the sentences that consist of the words of which they have extracted the meaning in the context of syntactic characteristics" (Güldenoğlu, Kargın, & Miller, 2015). In another definition Güleryüz (2002), indicated that the reading consists of seeing, perceiving, and making sense of the writings in the environment by subjecting them to certain mental processing and it is an act of understanding. When the definition of the reading in the literature is examined, it can be suggested that the reading consists of two stages namely the decoding and understanding.

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For the reading, which mainly consists of decoding and understanding, to be fully acquired, initially the readers must accurately decode the words followed by appropriately understanding the words decoded, and they need to accurately perceive the messages intended to be given by the sentences and paragraphs. Therefore, decoding skill is a critical prerequisite for the reader to become fluent in reading and to understand the text as well (Makhoul, 2017; Steensel, Oostdam, Gelderen, & Schooten, 2016). In the study of Güldenoğlu, Kargın, and Miller (2012), the researchers comparatively examined the word decoding and reading comprehension performances of good and poor readers. As a result, it was found that the differences found between the good and the poor readers were directly related to the word decoding performances, and there was a positive and significant correlation between word decoding and reading comprehension.

Word decoding, which is thought to be the first step necessary for reading to happen, is defined as the process of converting graphemes to their corresponding phonemes in accordance with the decoding rules and the individual's alphabet knowledge (Abou-Elsaad, Ali, & El-Hamid, 2015). Whether this process is reliably performed depends on the individual's phonological knowledge and skills (Cardoso-Martin, Mesquiata, & Ehri, 2011). In the studies in which word decoding processes were examined in detail, it was frequently emphasized that phonological knowledge and skills are one of the most powerful predictors of a successful decoding performance (Abou-Elsaad et al., 2015; Ehri, Nunes, Stahl, & Willows, 2001; Joseph & McCachran, 2003; Kjeldsen, Kärnä, Niemi, Olofsson, & Witting, 2014; Makhoul, 2017; Rakhlin, Cardoso-Martins, & Grigorenko, 2014; Report of the National Reading Panel, 2000; Schatschneider, Carlson, Francis, Foorman, & Fletcher, 2002; Share, 1995; Shaywitz & Shaywitz, 2005; Snow, Burns, & Griffin, 1998; Stanovich, 2000; Troia, 2004; Vellutino, Fletcher, Snowling, & Scanlon, 2004). Moreover, the limitation in this skill is one of the most important indicators of parameters used to identify poor readers starting from the first years of elementary school to adulthood (Nelson, 2005; Reid, 2009; Spira, Bracken, & Fischel, 2005; Vellutino et al., 2004). In this regard, practices that would support phonological knowledge and skills in the early period might be effective in eliminating future reading problems (Abbott & Berninger, 1999; Goodman, Libenson, & Wade-Woolley, 2010; Torgesen & Hudson, 2006).

Phonological knowledge and skills are considered in two groups as the phonological awareness in the early years, and the phonological decoding with the initiation of formal reading instruction. In the most general definition, phonological awareness in the first group is being aware of the phonemes that constitute a word (Goswami & Bryant, 1990). Phonological awareness, which includes the tasks such as recognizing, identifying, manipulating the phonemes that constitute words and recognizing words which consist of the same sounds, a skill that is seen as the critical skill to more easily grasp the relationship between the letter and its sound in the following years, requires mental processes such as thinking about, identifying, and being aware of the sounds in a language (Anthony & Francis, 2005; Erdoğan, 2011; McBride-Chang, 1995; Torgesen & Wagner, 1998). The research has shown that phonological awareness skills are an important predictor for future success of reading and this skill develops long before the more formal reading instruction, and it contributes to the reading skills by continuing to develop during the process of reading achievement (Durgunoğlu & Öney, 1999; Güldenoglu, Kargın, & Ergül, 2016; Olofsson & Niedersoe, 1999; Phillips, Menchetti, & Lonigan, 2008; Pullen & Justice, 2003; Segers & Verhoeven, 2005; Süel, 2011). Moreover, it also appears in different research studies as a frequently emphasized finding that the children who receive instruction on phonological awareness are more successful in achieving future reading skills than children who do not receive any instruction (Beauchet, Blamey, & Walpole, 2010; Oudeans, 2003). Akoğlu and Turan (2012) examined the effects of the instruction to develop phonological awareness skills on reading performance and found that students who had received phonological awareness instruction had better reading performance than students who had not received such instruction. In another study conducted by Güldenoğlu et al. (2016), the researchers longitudinally investigated the effects of phonological awareness skills that the preschool children achieved during early years on their reading and reading comprehension performance in the first grade. The results of the study showed that phonological awareness had positive effects on further reading and reading comprehension performance. With

regard to the content and practices, phonological awareness is examined during the preschool period whereas from the first grade this skill is transformed into phonological decoding and it is mostly targeted based on letter/syllable-phoneme conversions. From this aspect, phonological awareness is perceived as a fore-step for future phonological decoding.

Phonological decoding skill, which begins with the formal reading instruction during the first grade, is defined as the process of grapheme to phoneme conversion (Bowey, 1996; Kirby, Desrochers, Roth, & Lai, 2008). As it can be understood from its definition, phonological decoding skill, is stated as a skill area that basically involves letter/syllable-phoneme conversion and the readers' accurate phonation of the words encountered in the written text based on their available phonological structures. The related studies showed that in a language such as Turkish, which has a transparent orthography, sufficient phonological decoding skills can make a significant contribution to the word decoding process (Babayiğit & Stainthorp, 2007; Caravolas, Volin, & Hulme, 2005; Durgunoğlu & Öney, 1999; Öney & Goldman, 1984). It is indicated that since each letter has a corresponding one phoneme, while reading in Turkish, if the readers have sufficient phonemic conversion (letter/syllable-phoneme conversion) skill this will lead to faster and easier decoding of the words encountered in the written text yielding more time to allocate for comprehension during reading (Durgunoğlu & Öney, 1999; Peynircioğlu, Durgunoğlu & Öney, 2002; Raman, Baluch, & Besner, 2004; Raman & Weekes, 2005; Raman, 2006). In a study conducted by Makhoul (2017) the role of phonological decoding on reading was examined. A total of 206 first graders, of which 25 was at risk, were provided with instruction on phonological decoding and the results showed that there was a positive and significant relationship between phonological awareness skills and reading performance. In this regard, even though phonological decoding seems to lack a direct effect on reading comprehension, it is directly related to the word decoding, which is one of the basic components of comprehension, phonological decoding might have positive effects on reading comprehension as well.

When two principal word reading theories (phonological/single route and the dual route reading theory), which demonstrate reading achievement processes in detail are examined, it can be seen that phonological decoding has a critical place in both of them and it is stated as the common ground between these two theories (Coltheart, Rastle, Perry, Langdon, & Ziegler, 2001; Frost, 1998; Ramus, Pidgeon, & Frith, 2003). The first theory, which is the phonological/single route word reading theory, shows that word reading process occurs through phonological decoding. During this process, the readers decode the words by firstly decoding the phonemic structures that constitute the words followed by appropriately reuniting the structures they have decoded. In the literature, it is suggested that even though they do not have any intellectual disabilities the readers who have impairments in phonological knowledge and skills are usually considered as poor readers and these readers generally have limitations in connecting letters/syllables-sounds during the word decoding process, and a result of this they cannot sufficiently achieve reading fluently and comprehension (Baydık, 2002; Baydık & Bahap-Kudret, 2012; Furnes & Samuelsson, 2010; Orsolini, Fanari, Cerracchio, & Famiglietti, 2009; Roth, Toria, Worthington, & Handly, 2006). The second theory, which is the dual route reading theory, suggests that during the word decoding the readers use two routes as the vocabulary based and non-vocabulary based (phonological). In the first route, which is non-vocabulary based, the readers do the decoding by transforming the graphemes consisting words into phonemes likewise in phonological reading theory. In the second route, which is vocabulary based, the readers decode the words they encounter in the written text orthographically / based on mental illustrations. During the decoding, the readers who use this route do not decode the word they encounter by transforming letters to sounds instead from their memory they recall the word's correspondence which suits with the spelling of the word. In this regard, for this route to be actively used, the reader must be either an experienced reader or she/he sufficient prior input related to the words encountered in the written text (Jackson & Coltheart, 2001). According to the dual route reading theory, none of the routes is superior to or more accurate than the other. According to the familiarity of the reader with the words encountered during reading, if the reader uses both routes actively she or he could be more successful in decoding, and thus this would improve her or his reading fluency and reading comprehension (Paap & Noel, 1991;

Therrien, 2004). As a conclusion, when the information provided by both word reading theories are considered together, for the readers to be successful in decoding words, they need to have a certain level of phonological knowledge and skills. When beginning readers or readers who have more limited reading experience are considered, the role of the phonological knowledge and skills on word decoding speed and accuracy, in other words on decoding fluency, becomes much more evident.

Fluency in word decoding is the process of decoding the words encountered in the written text with sufficient speed and accuracy. As it can be inferred from its definition, the most important indicators of the fluency are the word decoding speed and accuracy (Bashir & Hook, 2009; Hasbrouck & Tindal, 2006; Klauda & Guthrie, 2008; Rasinski, 2004; Yıldız, 2013). Word decoding fluency serves as a bridge between the decoding skill and reading comprehension (Pikulski & Chard, 2005; Silverman, Speece, Harring, & Ritchey, 2013). In this regard, the first goal of reading is accurate decoding, and the second is doing it with sufficient speed. Several research studies in the literature show that there is a positive and significant relationship between word decoding fluency and reading comprehension (Baştuğ & Akyol, 2012; Biancarosa & Cummings, 2015; Calet, Defior, & Palma, 2015; Ouellete & Beers, 2010; Yıldırım, 2013; Yıldız, 2013). When the hierarchical order in the word decoding fluency is reviewed, it can be seen that the readers must reach a certain level of competence in accuracy and then in decoding speed (Hudson, Lane, & Pullen, 2005).

Accuracy in word decoding is pronouncing/vocalizing the words in the written text accurately. This skill includes understanding alphabetical principles (letter-sound conversions) unique to a language, recognizing syllable combinations, and having a large vocabulary (Başaran, 2013). For the word decoding accuracy, the criterion for the reading accuracy rate in the literature is reading 90-95% of the words in the written text accurately (Brassell & Rasinski, 2008; Lo, Cooke, & Starling, 2011; Piper, 2010; Rasinski, 2003; Vaughn & Linan-Thompson, 2004).

Another indicator of word decoding is the readers' speed of word decoding (Hudson et al., 2005). Word decoding speed is defined as the fast and accurate decoding of the words without stopping or stumbling. In this regard, word decoding speed is a critical point for the reading to be more fluent and intelligible regarding both the reader and the listener. In the literature, measurement of the number of words correctly decoded is considered as the criterion for word decoding speed (Caldwell, 2007; Hasbrouck & Tindal, 2006; Massey, 2008; Piper, 2010; Rasinski, 2004; Reutzel, 2006; Yeo, 2008). For the decoding speed, as well as for the accuracy, the readers must become competent/experienced in phonological knowledge and skills.

As a conclusion, due to the information mentioned above, phonological decoding skills are critical for word decoding, which is the first goal of reading achievement, in the first place, and then they are very important and necessary for reading comprehension. When the recent studies in the field of reading conducted in Turkey are examined, especially it can be seen that there are findings showing that for a successful reading performance, phonological knowledge and skills must be sufficiently acquired (Akoğlu & Turan, 2012; Erdoğan, 2011, 2012; Güldenoğlu et al., 2016; Süel, 2011; Turan & Akoğlu, 2011; Turan & Gül, 2008), thus making this for the researchers a topic of priority to examine in their studies. On the other hand, the studies conducted regarding this topic show that in most of the studies the researchers examined the effect of the phonological knowledge and skills on the initial reading achievement, which is targeted with phonics-based reading instruction (Erdoğan, 2011; Güldenoğlu et al., 2016; Karakelle, 2004; Süel, 2011; Turan & Akoğlu, 2011; Yücel, 2009), but the effects of these skills on reading performance in different grade levels are not presented with concrete data. Thus, this might have led to a common misunderstanding that in implementation phonological knowledge and skills are only used during the initial reading achievement. Yet, in the international literature it is emphasized that this skill is effective in initial reading achievement as well as on fluent reading skills and indeed there is a linear relationship between these two skills (Abou-Elsaad et al., 2015; Frost, 1998; Kjeldsen et al., 2014; Makhoul, 2017; Samuels & Farstrup, 2006). When regarded from this point of view, examining whether such an important skill, which is at the center of reading fluency, contributes to the reading fluency performances at the different grade levels, is seen important to

identify what type of interventions do poor readers from different educational levels need for reading fluency. Therefore, the problem of this study is to examine the relationship between the phonological decoding skills and word reading fluency of readers from different grade levels (first, fourth, and eighth grades).

Aim of the Study

The general purpose of this study was to examine the relationship between the phonological decoding skills and word reading fluency from a developmental perspective. Regarding this general purpose, the answer to the following question was sought, and the research hypotheses proposed for this question were tested.

Research question; is there a relationship between the phonological decoding skills and word reading fluency?

Hypothesis 1: Phonological decoding performances of the participant students in the study will linearly increase in line with the grade levels of the students.

Hypothesis 2: When the students who participate in the study are divided into two groups, the ones with good phonological decoding skills will read both faster and more accurately than the other group with poor phonological decoding skills.

Hypothesis 3: There will be a positive and significant relationship between the phonological decoding skills and word reading fluency for all the students in the study (both the whole group and separately for each grade level).

Hypothesis 4: The level of significant relationships which are expected in the previous hypothesis will decrease when the grade level increases.

Method

Research Design

This study, which aimed to examine the relationship between the phonological decoding skills and word reading fluency from a developmental perspective, was conducted in a descriptive survey model.

Study Group

The study group consisted of 300 students, of which 100 were first graders, 103 were fourth graders, and 97 were eighth graders, from three elementary schools and two secondary schools which are affiliated with Ministry of National Education (MoNE) in Ankara, Turkey (Table 1). Schools in this study are of low socioeconomic status, all the students volunteered to participate in the study, and the schools which had the appropriate physical hardware for the study to be conducted were chosen.

Table 1. Distribution of the Students in the Study Group According to Gender and Grade Level

	1st graders (n)	4th graders (n)	8th graders (n)	Total (n)
Male	49	55	46	150
Female	51	48	51	150
Total	100	103	97	300

While the study group was formed, sampling was not preferred. Instead, certain criteria were identified for the participant students. These are as follows;

a) not having any diagnosed disabilities (learning disabilities, emotional and/or behavioral disorders, intellectual disabilities, and so forth),

b) word reading skills at the independent level (95% or more reading accuracy)

c) having an academic performance at the average level of the classroom.

During the formation of the study group, for the criterion (a) and (c) the classroom teachers and school counselors were consulted and the student files at the school archives were examined. For the students for whom their teachers and counselors indicated that they met the criterion (a) and (c), reading assessments were conducted to identify whether the students met the criterion (b). If the result of the assessment indicated that the student had 95% or more reading accuracy, she or he was included in the study. Students who did not meet the identified criterion for reading accuracy were excluded from the study. As a result of these assessments a total of 300 students, who were thought to meet the criteria of this study, were identified and the study was conducted with these students.

Materials

Two separate assessment tools were used in this study to measure the participants' phonological decoding skills and reading performances. These consisted of Phonological Decoding Assessment Tool and Reading Texts. These tools were described in detail in the following sections.

a) Phonological Decoding Assessment Tool (PDAT)

In this study to assess the phonological decoding skills of the participants the Nonword Reading Assessment Tool (NRAT), which was developed by Güldenoğlu (2016), was used. During this task, students were presented with two nonwords on a computer screen, and they were asked to indicate whether these two words were the same or different as quickly as possible.

During the development of the tasks, two main criteria were considered. These were as follows: (a) Two-word pairs which included different words had a similar number of letters and syllables, (b) for the tasks one word in the word pairs was written cursively while the other was written vertically.

This task has 42-word pairs, of which 21 have the same two words and 21 have two different words. Another point in determining the word pairs was that the word pairs which included two different words had a similar number of letters and syllables. For example, two nonwords, such as "yasnelda - pekeltos," in the different word pairs have eight letters and three syllables. Moreover, for this task, one of the words in the word pairs is written with vertical letters whereas the other is written cursively. The reason was not to let students depend only on perception (only visual/perceptual level) while making the decision that the words were the same or different when they encountered word pairs with the same number of letters and syllables, in other words, this was done to have them use their phonological decoding skills (Güldenoğlu et al., 2012; Kargın et al., 2011; Kargın, Güldenoğlu, & Miller, 2014; Miller, 2004a, 2004b, 2005, 2006a, 2006b; Miller, Kargin, & Guldenoglu, 2014).

Tablo 2. Distribution of the Words Regarding Their Number of Syllables in the Assessment Tasks of the Nonword Reading Skill

Number of Syllables	Nonwords		
	n	Sample Items	
One Syllable	6	lok - lok	✔ *
Two Syllables	12	dike - ekir	X*
Three Syllables	12	yasnelda - yasnelda	✔ *
Four Syllables	12	zeyevinlot - basliyigar	X*
Total	42 items (21 had the same nonword pairs-21 had different nonword pairs)		

Note: ✔ *: The pair has the same words

   X *: The pair has different words

During the task, the software was used namely DMDX (DMASTR; developed at Monash University and the University of Arizona by K. I. Forster and J. C. Forster; http://www.u.arizona.edu/~kforster/dmastr/dmastr.htm). This program is a computer program which can automatically record the timing and accuracy of the participants' answers to enable the implementer to analyze the answers after the assessment.

b) Reading Texts

In order to assess the word reading fluency performances of the participants in this study, texts which were identified at the grade level were used, and the participants were asked to read these texts aloud. The text used for the 1st graders was a tale, 4th graders was an expository text, and the 8th graders was an epic story. In this process, the texts to be used that would be appropriate for the grade level were chosen from the Turkish books which were certified by the MoNE. Thus, one text from each grade level was chosen from the course books yielding three texts in total. During the identification of texts, the criteria for word numbers which were suggested by Akyol (2012) were used. These were as follows:

a) For the first and second grades 25-100 words,

b) For the third and fourth grades 100-200 words,

c) For the fifth and sixth grades 200-300 words,

d) For the seventh and eighth grades 300-350 words.

When the above criteria were considered, the text prepared in this study for the 1st graders included 76 words, for the 4th graders included 175 words, and the one for the 8th graders consisted of 322 words. All the texts were written on an A4 paper with a font size that was thought to be appropriate for the grade level. During the assessment, the students were provided with the following instruction: *"Now I will give you a text to read. I want you to read the text as quickly as possible aloud, all right?"* and then when the student answered *"All right."* the text was presented. Throughout the assessment process, readings of all the students were recorded with a voice recorder to enable the researchers to analyze them later.

Data Collection

Before collecting data, schools to be included in this study were identified in the district of Mamak in Ankara, and then necessary permissions were taken from the city and provincial directorates of national education. Following the reception of the permissions, the schools were visited and an appropriate place, date, and available hours for the assessment procedure were identified in cooperation with the school principals. Following this, teachers and school counselors of the classrooms where the study would be conducted were met, and the purpose and content of the study were explained to them.

Pilot Assessment

Before the actual implementation of the assessment, a pilot assessment was conducted to identify the issues that would be encountered during the actual data collection. The pilot assessment was done with a group of students who had similar characteristics likewise the actual study group and included 15 students (8 girls-7 boys). The assessments lasted about 10-15 minutes with each student. Since there was a permission issue, in only one of the assessments the process was recorded with a video recorder however in 14 of them only voice recorders were used. The recordings were analyzed after the assessments were completed. Some decisions were made following these analyses that are presented below.

During the pilot assessment, the principals of the schools to be included in the actual study group were informed that the assessments needed to be conducted in a more silent place. The first place which was arranged was the school counselor's office; however, since students came into the room to consult with the counselor during the assessments for this study, it was seen that the students in the pilot group got disturbed.

It was decided that the researcher who would conduct the assessments would place a notebook nearby. Thus, it would be possible to write down if any occasion occurred that would make the student be excluded from the study.

Study Group Assessments

Before the assessments of the students in the study group, the school principals were requested to provide an appropriate place for the assessments. This place later was organized appropriately for the assessments, and then the students were individually called to the room.

When the student came into the room, the researcher introduced himself and then the purpose and content of the procedure were briefly described. It was emphasized that there would not be an exam, the study would not affect their grades, and therefore they could be comfortable followed by the initiation of the assessment. All the assessments were conducted in the same order. Firstly, the Phonological Decoding Assessment Tool was conducted, and then it was followed by the conduction of Readingtexts.

When the Phonological Decoding Assessment Tool was conducted, the related file from the DMDX program was chosen, and then the following instruction was given *"Now, you will see two words on the computer screen. I want you to read the words on the screen as quickly as possible, and if the words are the same push the green button, if they are different push the red button. If you do not push any buttons in 5 seconds, the words will automatically change."* Following the approval of the student, the following instruction was given:*"Now to make it clearer we will do some practices together. Are you ready?"* and then the practice items were answered with the student. Later, the student was asked whether there was anything that she or he could not understand and with the answer of *"No,"* the test items were presented to the student. When the student finished answering all test items independently, the implementer recorded the performance of the student on the computer followed by the implementation of the Reading Texts.This tool was initiated with the following instruction likewise for the previous implementation of PDAT *"Now I will give you a text. I want you to read the text as quickly as possible aloud, all right?"* When the student answered *"All right"* The text was presented to the student. At this time when the student started reading, the researcher started to record it with the voice recorder, and he recorded the whole reading until the end. At the end of the assessment, the researcher thanked the student for her or his participation in the study and the assessment was then finalized.

Data Analysis

In order to examine the relationship between the phonological decoding skills and word reading fluency in this study, analyses were conducted in three stages. Firstly, the groups of students were formed in terms of students with poor and good phonological decoding skills. Secondly, the word reading fluency of the students in these two groups were compared. Lastly, the relationship between the phonological decoding skills and word reading fluency of the students in each grade were examined. For the data analyses, to identify student groups, K-Means Cluster Analysis, to compare the word reading fluency of the student groups, Mann-Whitney U test was used, later to determine the relationship between the phonological decoding skills and word reading fluency of the student groups Pearson Correlation coefficients were calculated.

Results

Formation of the Student Groups According to the Phonological Decoding Skills

In this study, to test the hypothesis of *"phonological decoding performances of the participant students in the study will linearly increase in line with the grade levels of the students,"* student groups of good and poor phonological decoding skills were formed. In order to form the groups, the means of correct answers of the students in the word decoding task were analyzed using K-Means Clustering, and the results of the analysis are shown in Table 3.

Table 3. Distribution of the Student Groups, which were Formed Regarding Phonological Decoding Skills, According to Grade Level

Group	1st grade	4th grade	8th grade	Total	$\bar{x}$ (sd)	Min.	Max.	P
Good	29	93	93	215	35.77 (4.23)	26.00	42.00	
Poor	71	10	4	85	15.65 (5.82)	3.00	25.00	.000
Total	100	103	97	300	30.07(10.24)	3.00	42.00	

When Table 3 is examined, it is seen that the students participated in this study formed two groups as good (n=215) and poor (n=85) in terms of their means in nonword decoding task. When the distribution of the students in the good and poor groups regarding their grade levels are examined, 29 of the first graders are in the good group, however 71 of them are in the poor group; for the fourth graders, 93 of them are in the good group, whereas 10 of them are in the poor group; for the eighth graders, 93 of them are in the good group, whereas 4 of them are in the poor group.

Comparison of the Students in the Good and Poor Groups of Phonological Decoding Skills Considering Word Reading Fluency

For the second hypothesis of this study which is *"when the students who participate in the study are divided into two groups, the ones with good phonological decoding skills will read both faster and more accurately than the other group with poor phonological decoding skill,"* students who had good and poor phonological decoding skills were compared in terms of word reading fluency scores by conducting three Mann Whitney-U tests. In the first analysis, the number of words accurately read for two groups, in the second analysis, their accuracy in reading, and in the third, the total time for reading the whole text was compared. The results of these analyses are given in Table 4.

Table 4. Mann Whitney-U Test Results of Students with Good and Poor Phonological Decoding Skills in Terms of Word Reading Performances

	Group	N	Mean Ranks	Sum of Ranks	U	p
Number of Words Accurately Read in a Minute	Good	215	185.07	39790.00	1705.00	0.00
	Poor	85	63.06	5360.00		
Total Number of Words Accurately Read	Good	215	183.31	39411.50	2083.50	0.00
	Poor	85	67.51	5738.50		
Total Time Spent to Read the Whole Text	Good	215	159.77	34350.00	7145.00	0.00
	Poor	85	127.06	10800.00		

Firstly, whether the groups in the study significantly differed in terms of means of reading speed was examined and the analysis showed that both the number of words read in a minute (U=1705.00, p<.01) as well as total time spent to read the whole text (U= 7145.00, p<.01) in the groups of good and poor decoding skills significantly differed. When Table 4 is examined, it can be seen that students with good phonological decoding skills read more words accurately and they finished reading the text more quickly than the students with poor phonological decoding skills.

Secondly, whether the groups in this study significantly differed in terms of word reading accuracy was examined, and the results of the analysis showed that there was a statistically significant difference between the students in the groups of good and poor phonological decoding skills (U=2083.50, p<.01). When the mean ranks in Table 4 are examined, it is seen that students with good phonological decoding skills read the text more accurately than the students with poor phonological decoding skills.

Examination of the Relationship Between Students' Phonological Decoding Skills and Word Reading Fluency

For the third hypothesis of this study which is *"there will be a positive and significant relationship between the phonological decoding skills and word reading fluency for all the students in the study (both the whole group and separately for each grade level),"* the relationship between students' phonological decoding skills and word reading fluency was examined by calculating the Pearson Correlation Coefficients between these two measurements. In this process, firstly coefficients for the whole group than for the grade levels, and lastly within the grade levels were calculated, and the results are given in Table 5.

Table 5. Correlations between Phonological Decoding (PD) and Word Reading Fluency

	PD	The Number of Words Accurately Read in a Minute	Total Number of Words Read Accurately	Total Time for Reading the Whole Text
ALL STUDENTS TOGETHER (n:300)				
PD		.735**	.741**	.249**
The Number of Words Accurately Read in a Minute	.735**		.869**	.096
Total Number of Words Read Accurately	.741**	.869**		.461**
Total Time for Reading the Whole Text	.249**	.096	.461**	
1st GRADERS (n:100)				
PD		.455**	.478**	-.457**
The Number of Words Accurately Read in a Minute	.455**		.543**	-.959**
Total Number of Words Read Accurately	.478**	.543**		-.376**
Total Time for Reading the Whole Text	-.457**	-.959**	-.376**	
4th GRADERS (n:103)				
PD		.298**	.278**	-.292**
The Number of Words Accurately Read in a Minute	.298**		.677**	-.962**
Total Number of Words Read Accurately	.278**	.677**		-.598**
Total Time for Reading the Whole Text	-.292**	-.962**	-.598**	

Table 5. Continued

	PD	The Number of Words Accurately Read in a Minute	Total Number of Words Read Accurately	Total Time for Reading the Whole Text
8th GRADERS (n:97)				
PD		.260*	.410**	-.206*
The Number of Words Accurately Read in a Minute	.260*		.564**	-.959**
Total Number of Words Read Accurately	.410**	.564**		-.489**
Total Time for Reading the Whole Text	-.206*	-.959**	-.489**	

*p<.05, **p<.01

When Table 5 is examined, it is seen that for all the participant students in this study (both in terms of the whole group and separately for the grade levels), there is a positive and significant correlation between the phonological decoding skills and the number of words accurately read in a minute. When all students are considered together, the correlation is very high, for the first graders it is moderate, and for the fourth and eighth graders, it is low (Table 5).

When the correlations between the phonological decoding skills and the total number of words read accurately, it can be seen that in all grades, except in the first grade, students' phonological decoding skills have positive and significant correlations with the total number of words read accurately. When all students are considered together the correlation is high, for the fourth graders it is low, and for the eighth graders, it is moderate (Table 5).

Lastly, when we look at the correlations between the students' phonological decoding skills and total time for reading the whole text, it is seen that there is a significant and negative correlation between the students' phonological decoding skills and total time for reading the whole text for all the students who participated in this study. When Table 5 is examined, it can be seen that these correlations for the first graders are moderate, for the fourth and eighth graders they are low.

Discussion and Conclusion

The general purpose of this study was to examine the relationship between the phonological decoding skills and word reading fluency from a developmental perspective. For this purpose, a total of 300 students from the first, fourth, and eighth grades participated in this study. Initially, the participant students were grouped as the good and poor readers according to their phonological decoding skills, and then the phonological decoding skills and word reading fluency of the groups were comparatively examined in line with the research hypotheses.

The first hypothesis of the study indicates that *"phonological decoding performances of the participant students in the study will linearly increase in line with the grade levels of the students."* The results verify this hypothesis that when the grade level increases the number of students with poor phonological decoding performances decrease (Table 3). For the relationship between the phonological decoding and word reading it is suggested in the literature that there is a linear relationship between these two skills, and this relationship occurs through mutual interaction (Frost, 1998, 2006; Güldenoğlu et al., 2012; Jackson & Coltheart, 2001; Kargın et al., 2011; Miller, 2004a, 2006a; Miller et al., 2014; Raman & Weekes, 2005; Ramus et al., 2003; Vaughn, Bos, & Schumm, 2003; Wauters, VanBon, & Tellings, 2006; Zaretsky, Kraljevic, Core, & Lencek 2009). Different studies conducted on this topic show that the higher the educational level of the students is the more experiences they have, and thus they will become more

skilled in the phonological decoding processes such as letter-sound, and syllable-sound conversions when the students' educational level increases (Beauchet et al.,2010; Bowey, 1996; Erdoğan, 2012; Güldenoğlu et al., 2012; Jackson & Coltheart, 2001; Kirby et al., 2008; Makhoul, 2017; Steensel et al., 2016). In the direction of this proposition, findings related to this hypothesis is consistent with the existing literature. Even though the first graders did not have good phonological decoding skills when the grade level increased the students might have become more experienced in reading and therefore with the increase in grade level more students were placed into the group of good readers. To verify these findings of the study related to the students in the good and poor groups, the second hypothesis was proposed, and the word reading fluency of the students in the groups of good and poor readers was compared expecting the results would be in favor of the students in the good readers' group.

The second hypothesis is that *"when the students who participate in the study are divided into two groups, the ones with good phonological decoding skills will read both faster and more accurately than the other group with poor phonological decoding skill."* The findings verify this hypothesis that the students in the good group read both more quickly and more accurately than the students in the poor group (Table 4). When the word reading speed of the participant students was examined, it was seen that students with good phonological decoding skills had a higher number of words read in a minute as well as shorter time to finish reading the whole text than the students with poor phonological decoding skills. This finding related to the word reading speed of the students with good and poor skills might indicate that the students were accurately grouped regarding their decoding performances. It is frequently emphasized in the literature that with the improvements in the competency of the readers in phonological decoding skills they start to decode more quickly leading them to become faster readers (Abou-Elsaad et al., 2015; Durgunoğlu & Öney, 1999, 2002; Ehri et al., 2001; Frost, 1998, 2006; Jackson & Coltheart, 2001; Kjeldsen et al., 2014; Peynircioğlu et al., 2002; Rakhlin et al., 2014; Ramus et al., 2003; Report of the National Reading Panel, 2000; Schatschneider et al., 2002; Share 1995; Shaywitz & Shaywitz, 2005; Stanovich, 2000; Troia, 2004; Vellutino et al., 2004). In this regard, it might be suggested that the students in the good group used these skills more actively than the students in the poor group making the students in the good group faster readers. Nonetheless, for this suggestion to be true by itself for the students with good and poor phonological decoding skills, all the decoding process of all the participating students during reading had to include phonological decoding. However, when the distribution of the students in the good groups regarding grade levels is examined, it is seen that most of these students were the fourth and eighth graders, and the majority of the students in the poor group was the first graders. This might suggest that the students in the good group might have used not only phonological decoding but also orthographical decoding skills as well and therefore this might have contributed to their word reading speed. It is frequently emphasized in the literature that the more the experiences and competence of readers in reading, the more they use orthographical decoding, thus they start to read faster (Jackson & Coltheart, 2001; Kargın et al., 2011; Kjeldsen et al., 2014; Miller, 2004a, 2004b, 2005, 2006a, 2006b, 2010; Paap & Noel; 1991; Rakhlin et al., 2014; Therrien, 2004; Young-Suk, Richard, & Danielle, 2012). In this regard, only examining the word reading speed of the participant students in this study could not provide enough proof for the effect of their phonological decoding skills on their reading performances. At this point, to identify the effects of such skills on reading performance, it is important to examine the groups' total number of words that are accurately read in the text. Despite the fact that the students in the good group are from higher grades, the texts used in this study were in accordance with their grade levels, so that even though the students were at the eighth grade, they might have not solely used orthographical decoding to read all the words they encountered in the text, at some point they could have needed to use phonological decoding as well.

The findings of this study are consistent with this notion, and the students with good phonological decoding skills read more words accurately than the students with poor phonological decoding skills.

When the results are examined, it can be seen that the difference between the accuracy of two groups in the study regarding text reading might be due to the differences in the existing phonological decoding performances of the groups. When the results regarding this hypothesis are considered together, it might be suggested that phonological decoding skill could have a positive effect on the speed and accuracy of reading and limitations in this skill would directly affect the reader's fluent reading skills. In order to examine how the findings were in different grade levels, the third and fourth hypothesis was suggested, and the relationship between the phonological decoding skills and fluent word reading skills were determined.

When the results for the third hypothesis of the study, which is *"there will be a positive and significant relationship between the phonological decoding skills and word reading fluency for all the students in the study (both the whole group and separately for each grade level),"* are examined it was seen that this was verified and there were significant relationships between the phonological decoding skills of the students and their fluent reading skills (Table 5). Several studies previously conducted have revealed that there is a strong relationship between the phonological decoding skills and reading fluency (Abou-Elsaad et al., 2015; Frost, 1998; Güldenoğlu et al., 2012; Makhoul, 2017; Samuels & Farstrup, 2006; Torgesen, 1999). The significant relationships shown in the results of the current study are consistent with the findings of the previous studies. The first analysis included all participants in this study, and the relationship between the students' phonological decoding skills and word reading fluency was examined. The findings showed that there were strong, significant, and positive correlations between the phonological decoding skills and the number of words accurately read in a minute as well as the total number of words accurately read, and there was a low but significant correlation between the phonological decoding skills and the total time needed to finish reading the whole text. The results regarding the number of accurately read words and accuracy in text reading are expected, and the finding regarding the total time for text reading in a way verifies the notion about the orthographical decoding which is indicated in the previous hypothesis. Depending on these results it might be indicated that the more skilled the students in phonological decoding skills, the faster and more accurate reader they become. On the other hand, since the students did not solely use phonological decoding during the text reading, this might have led to the low correlation between their speed in finishing reading the text and phonological decoding skills, but at some point they certainly needed phonological decoding, and this might have caused the low but significant correlation. To obtain more detailed information about this the fourth hypothesis that is *"the level of significant relationships which is expected in the previous hypothesis will decrease when the grade level increases"* was proposed and the relationships between the phonological decoding skills and word reading accuracy skills of students in each grade level were examined separately.

Firstly, when the correlations between the phonological decoding skills and the number of words accurately read in a minute were examined in each grade level, it was seen that even though significant at each grade level, while the grade level increased the correlation became relatively lower (Table 5). This might have indicated that the higher the grade level of the students the less they needed phonological decoding. It should be suggested that when the grade level increased, during the decoding of the limited number of words encountered in a very limited time like one minute, the students might have encountered more familiar words and they might have needed less phonological decoding, thus leading to these results.

When the correlation between the total number of words accurately read in the text and phonological decoding was considered, this correlation was high for the first graders, whereas for the

fourth graders it was low, and for the eighth graders it was moderate. These results might have been due to two basic factors. One of them is the transition from intensive use of phonological decoding strategy to the orthographical decoding strategy when the grade level increases and the other one includes the phonological structure, difficulty, and familiarity of the words in the reading texts. Following an intensive phonological decoding instruction for the first graders who participated in this study, it might have been natural to focus on phonological decoding strategy while decoding as well as they would have a little or no use of orthographical decoding strategy due to limited reading experiences. For these reasons, a higher correlation between the accuracy of text reading and phonological decoding skills at this grade than the other grades are natural. The fact that the correlation between these two skills is lower in the fourth grade might be due to the transition mentioned above to orthography. Even though they had intensive phonology focused instruction until they reached the fourth grade they had experiences in reading so that the fourth graders might have developed an orthographical repertoire. Therefore, it is thought that during reading, these students would not solely need phonological decoding as much as the first graders and thus there would be a lower correlation between their phonological decoding skills and text reading accuracy than the first graders. On the other hand, if these findings could be explained by only the transition to orthography, a decrease would be expected in the correlation between these two skills for the eighth graders when compared to the fourth graders. However, the results showed that the correlation between these two skills in the eighth grade was higher than the fourth grade. This is thought to be the consequence of the second factor, that is the word structures in the text and the familiarity with the words. When the text which was used in the assessments of this study was examined, it was seen that the text for the eighth graders was an epic story and it had number of words that had more complex structures and were less familiar (e.g., Uruz Koca [unfamiliar proper noun], oğlancığımdır [a word saying, 'he is my boy'], erkeçe [goat], yaldır yaldır yaldırır [having glittering and various colors], mahmuz [spur]) than the other texts. Moreover, the students in this study were from low socioeconomic status, and this might have caused less experience in reading, and therefore they might have used phonological decoding more while reading. In the dual route word reading theory, it is indicated that the readers should use both routes of decoding successfully during reading and even though the educational level and/or the reading experiences increase, the readers automatically turn to the phonological decoding route when they are encountered with less frequently used words or words having unfamiliar structures while reading (Jackson & Coltheart, 2001; Vaughn et al., 2003; Wauters et al., 2006). When this notion is considered, in this study, the texts used with eighth graders had more difficult word types and structures, even though students were orthographically decoding as well, and they used this route more, during the assessments with this text, due to the characteristics of the text, the eighth graders when compared to the fourth graders might have used phonological decoding skills more. Therefore, based on the text used for the assessment, there might have been a higher correlation between the fluent reading skills and phonological decoding skills at this grade level than the fourth grade.

The significant but negative correlations between the phonological decoding skills and the total time to finish reading the text might support the notions mentioned above. The findings show that in each grade level the better the phonological decoding skills, the faster the students read. However, the degree of the significant correlation between these two skills decreases. When this finding is comparatively examined by grade levels, it is seen that the above-mentioned assumption is more powerful for the first graders since phonological decoding is more intensive, when the grade level increases the phonological decoding intensity relatively decreases thus having less powerful correlations showing that the power of this assumption decreases for the fourth and eighth graders.

As a conclusion, when all the information provided above are considered together, it should be suggested that independent from the grade level, phonological decoding skill is closely related to the word reading fluency, and it has important effects on fluency. The findings of this study show that the phonological decoding skill is a very critical skill to be learned especially for the first graders. Moreover, the findings show that independent from the educational level, even though they have a certain level of orthographical repertoire, all readers still need to reach a certain competence in the phonological decoding skills to become fluent readers. In this regard, in the light of the findings of this study, it can be suggested that the phonological decoding skills can be accepted as one of the most important indicators of fluent reading.

Based on the results of this study, it would be appropriate to present some suggestions to experts, practitioners and teachers who are working in this field. Firstly it should be noted that it is important to determine the source of the difficulties which students experienced in reading and to support them with the appropriate interventions. At this point, it is essential for the experts to meet their students with the evidence-based practices which are effective in phonological decoding to eliminate their existing shortcomings. In this process, it is suggested that the experts working with students with reading difficulties should focus on their basic phonological analysis skills (letter-sound, syllable-sound transformations), and support their reading fluency after they reach a certain proficiency in phonological decoding performances. In addition, it can be suggested that experts can improve their knowledge and make themselves better equipped related to phonological analysis strategy teaching which are stated to be effective for teaching word decoding skills.

There are certain limitations in this study that should be communicated to the readers. The first limitation is that the population was limited with a total of 300 students. Hence it is considered that future studies should multiply the number of samplings and reenact the same research so as to validate the generalization of current findings. Second limitation is that present study relates to only the phonological decoding and word-reading fluency. It is thus suggested that in future, by controlling participants' reading performances with respect to different variables (reading fluency and reading comprehension etc.) and recapping the same experiment, findings obtained from present study should be further also generalized. Finally, this study is limited to the word decoding level of reading. Therefore, it is thought that the findings obtained by analyzing the effects of phonological decoding on reading fluency and reading comprehension will provide important contributions to develop effective interventions for students who have reading problems.

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