Interdisciplinary Research in Education
Volume 8, Issue 1, 2023: 105-124
DOI: https://doi.org/10.3126/ire.v8i1.56731

Identification of at Risk Early Grade Children of Dyslexia by Using Prereading Skills in Nepal

Krishna Bahadur Thapa, PhD
Assistant Professor,
Tribhuvan University
Department of Special Needs Education, Sanothimi Campus, Bhaktapur
Email: krishna.thapa@sac.tu.edu.np

Keywords

Dyslexia,
at the risk children,
general prevalence
prereading skills
Nepal

Abstract

In developing countries like Nepal, dyslexia is still an unfamiliar subject for both public and academic professionals; however it needs to be identified among Nepalese children. The study aimed to (i) estimate children at the risk of dyslexia as a general prevalence among Nepalese primary school children (ii) explore a set of predictive variables in identifying children at the risk of dyslexia, and (iii) compare early grade reading skills of children at the risk of dyslexia with age and grade-matched control group. Altogether, 554 children from grade 3 through 5 were screened by their grade teachers employing an adapted TSQ which identified 75 children having most difficulty either in reading, spelling, basic mathematical operations and behaviour problems by direct assessment administering RSAET. Their performance was compared with a control group of 86 peers. The findings revealed that 13.54% of children, out of 554, were estimated at the risk of dyslexia at the screening stage, but it was 12.63%, verified by a direct assessment can be considered as the general prevalence of dyslexia in Nepal. The logistic regression analysis classified the risk and control groups with a high accuracy of 91.89% based on the RSAET where prevailing sensitivity of 93.33% and specificity of 91.86% were estimated. Syllabication error, among others, was identified the most influential predictor in identifying children at the risk of dyslexia. It was also found that children at the risk of dyslexia exhibited poor reading skills. Overall findings of the present study indicate that a significant number of early grade children are at-risk for dyslexia in Nepal. The findings are consistent with the prevalence of dyslexia reported by international studies. It highlights a need for full-fledged diagnostic studies that may reveal the actual picture of dyslexia in Nepal and manage education following inclusive approaches.

Introduction

Dyslexia, in general, refers to deficits in developmental literacy acquisition that mainly persists across reading, spelling, writing, comprehension, speech-sounds and language expression. Basically, dyslexia has a neurobiological abnormality (Ramus et al., 2003; Snowling, & Hulme, 2013; Martin, Kronbichler, & Richlan, 2016) and genetic endowment (Snowling, & Hulme, 2013) that appears with deficits in cognitive process (Ramus, 2003; Ramus et al., 2003; Hulme, & Snowling, 2013). It is a condition of having significant discrepancy between reading and written codes where disorders are reflected in grapheme–phoneme correspondences (Fox, 1994). Importantly, dyslexia is more than disorders on reading and writing codes correspondences, but it represents significant deficits on cognitive related tasks like deficits in speed of processing, short-term memory, sequencing tasks, auditory and visual perception, motor skills etc. (Snowling, & Hulme, 2013; Goswami, 2015). Deficits occur even when having average or above intelligence while disregarding any racial factor, socio–economic status and lack of learning opportunities (Zabell, & Everatt, 2000; Ziegler, 2006). It affects a significant number of children globally. According to the International Dyslexia Association (2006), 20% of the population exhibits some form of learning disability, from which 85% are considered struggling with dyslexia. Similarly, the prevalence among the school children of 7-to-12-years of age was reported to be 13.67% (Rao et al., 2017).

Children with poor pre-reading skills who are potentially at the risk for reading difficulties should be recognised as early as possible. Early recognition of risk for reading disorders and dyslexia should be needed to consider as more serious problems among the at the risk children. In Nepal, USAID (2014) conducted a nationally representative Early Grade Reading Assessment (EGRA) which provided concrete data on the foundational reading skills of Nepalese children. The assessment found that 34% of second graders and 19% of third graders could not read a single word of Nepali. Students in the Terai had both the lowest mean oral reading fluency score and the highest zero scores compared to other regions of Nepal and were, on average, reading 12 correct words per minute fewer than students in the Kathmandu Valley. This assessment demonstrated the dire need for a National Early Grade Reading Program to improve the reading skills of Nepali students (USAID, 2014). Likewise, the enrollment rate in basic education was reported to be 97.1% from grade one to five, but it dramatically decreased to 87.4% for grade six to eight respectively accounting for drop-out cases (Ministry of Education, 2018). It is argued that learning disorders like dyslexia, poor reading have significant impact on drop-out issues and strong association is reported between these two variables (Al-Lamki, 2012). However, it remains yet to be investigated whether or not a contribution of learning related disorders on drop out of Nepalese school children. Despite the given statistical reportings of developing countries, basically in countries of South Asia such as Nepal is one of them, has not yet recognised such issues of learning related disorders of at the risk children (Ho et al., 2004; Lee, 2008).

Education and dyslexia in Nepal

After 2016, new structure of school education has been introduced in Nepal that changed previous ones extending basic and secondary education (Regmi, 2017). Prior to this, there was a primary education from grade 1 to 5, lower secondary education from grade 6 to 8, secondary education from grade 9 to 10 and higher secondary from 11 and

12 respectively. In the present time, basic education refers to education from grade 1 to 8 that is accessible to all children in the sense that it is compulsory and free while secondary education starts from grade 9 to 12 offering free education. Preschool education exists in Nepal in some areas and schools but it is not under the formal structure of the education system yet. Generally, children after the age of 5 enter into first grade in Nepal where rigid criteria is not applied. Children who are assumed to have normal cognitive abilities and without any known behavioural issues to go mainstream school whether children having low IQ, autism, down syndrome as well as physical and known sensory impairments are sent to special schools. By the term mainstream schools, we refer to schools that take the general population of students without any intellectual filtering.

In the Nepalese context, study of dyslexia among school children seems to be significant in a sense that there is a crucial lack of scientific information about cognitive related disorders like dyslexia. There are different issues that need to be addressed in the field of learning disorders in the Nepalese context. The Ministry of Education's publication on the National Early Grade Reading Program (2014-2020) has tried to acknowledge this problem and has drafted specific strategic plans to address to some extent (Ministry of Education, 2014). Attention must be paid on considering dyslexia as a genuine disability rather than an academic failure only. Even though the teachers and counsellors are not fully aware of dyslexia, there is a specific lack of tools in the Nepalese language and grading system of severity level which has made assessment and certification difficult. Although the children are diagnosed the lack of options of choosing subjects in school or giving some extra time in exams generate an additional difficulty. Dyslexia indeed impacts on learners' educational achievement and as its prevalence is growing as a public concern. Therefore, it is an accountability of all the stakeholders to take steps in the research and management of cognitive linked disorders in Nepal.

Prevailing assessment techniques to assess prereading skills

Many prior studies signify that the common underlying principle for being identified as an at-risk student is problems in letter understanding and identifying letter-sounds correspondance. To ensure accurate identification, the screening batteries should cover several skill areas related to developing reading skills, such as phonological skills, orthographic and letter knowledge, word reading, vocabulary, and syntactic ability (Bailey, & Drummond 2006; Davis et al. 2007). To accurately classify students into at-risk and not at-risk for poor reading outcomes, it is important that the screens are targeted at reading skills, and that the content is age-appropriate (Jenkins, Hudson, & Johnson, 2007; Compton, et al. 2010).). However, the accuracy of screening measures differs with respect to sensitivity and specificity (Catts et al. 2015; Compton et al., 2010; Johnson et al., 2009).

Sensitivity refers to the degree of true positives, meaning how accurately the measure identifies students at high risk for reading difficulty. Specificity, on the other hand, refers to the degree of how accurately the measure identifies students at low risk for reading difficulty. The fact that a test discriminates against poor readers at the group level does not necessarily guarantee accuracy in predicting difficulties at the individual level (Puolakanaho et al. 2007). The quality of the predictor is determined by how well it is able to capture the true-positive cases that turn out to have reading disorders at school age, and

to avoid false-positive cases that predict risk for reading disorders although the children do not have difficulties in reading at school age.

According to the literature, teachers' assessment practises can be divided into three categories: tests comprising screening or individual test batteries, (performance-based assessment), curriculum based measures (CBM), and qualitative assessments such as observations in the classroom (Bailey, & Drummond 2006; Sudkamp et al. 2012). One way to assess student progress toward long-term curriculum goals in literacy learning is CBM, which is the main tool of screening difficulties, learning difficulties and the risk for reading disorders in the response to intervention (RTI) framework (Stecker, Fuchs, & Fuchs, 2005; Madelaine, & Wheldall, 2005). CBM may be used to observe students' progress in an entire school or classroom, to track an individual's progress toward end of year benchmarks or individualised education program goals, or to screen students at a specific time point to determine their level of risk for academic failure (Deno, 2003; Zumeta, Compton, & Fuchs, 2012).

A number of previous studies (e.g., Bailey, & Drummond, 2006; Beswick, Willms, & Sloat, 2005) have shown that teachers' evaluations and their perceptions of a student's risk for literacy failure can be used as early as the beginning of kindergarten and the first grade to identify signs of reading disorders. In Bailey and Drummond's (2006) study, kindergarten and first-grade teachers were asked to identify one to four students in their class who perceived to be at the risk for reading difficulties, but who were not receiving any formal remediation at the moment. They used literacy development checklists (Bailey et al. 2001) and also concept maps based on targeted early literacy skills, such as decoding, letter-sound correspondence and phonemic awareness. However, according to Bailey and Drummond (2006), the data teachers rely on when rating students' reading performance may not allow for making accurate judgments of particular pre-reading skills. Teachers' decisions seemed to be sometimes based on situational or other irrelevant factors (e.g., gender, behaviour, students' ability to work in groups), instead of solely performance assessments (Beswick et al. 2005). They might also have insufficient knowledge or competence to identify students' reading disorders (Bailey, & Drummond 2006; Sudkamp, Kaiser, & Moller, 2012). In addition, Bailey and Drummond (2006) noted that some teacher characteristics, such as years of teaching experience and personality, affect the accuracy of teacher judgments. Furthermore, teachers have been shown to have a tendency to underestimate the reading skills of those students who have had prior weaknesses in reading, and whose general cognitive skills are at a low level in combination with previously identified special needs children (Soodla, & Kikas, 2010).

Overall, proper assessment is necessary in order to identify the children with dyslexia, and to take measures to minimise their sufferings which may otherwise result from multiple consequences of those disabilities in their learning and social life. It is common that a child who may be at high-risk of dyslexia starts showing early signs of reading difficulties in the first grade itself. Thus, scientific assessment at an early stage is crucially important for identifying such children which may prevent them from academic failure, psychological, academic and other behavioural difficulties. In addition, it is important in classifying and planning intervention as well as planning of special

needs education and compensation programs in a timely manner. Identifying children at the risk of dyslexia requires examining predictive factors which can differentiate positive cases correctly (Thompson et al., 2015)

Lower reading speed and accuracy

Reading speed and accuracy are the areas that need to be explored while measuring the reading performance during the plan and process of identification of dyslexia. Potential candidates of dyslexia exhibit poorer performance in such domains. Empirically, a study carried out by Tressoldi, Stella and Faggella (2001) among children from second through eighth grade in Italy that revealed children with dyslexia demonstrate a relatively slower reading speed than normal readers. They also opined that this sort of deficit occurs due to lack of atomization on reading. In this regard, Pavlidis (1981a) argued that such slower performance exists due to brain malfunctioning that is reflected in both verbal and nonverbal sequential tasks. Consequently, relatively slower reading speeds and low scores on reading accuracy are demonstrated by dyslexics. It is commonly acknowledged that the children with dyslexia always face struggling with phonological representation which has a direct connection to the slow reading speed and poorer reading accuracy (Rayner et al., 2001; de Jong, & Van Der Leij, 2003; Serrano, & Defior, 2008).

Reading and spelling errors

Frequency and types of reading errors are other indicators that might also be helpful to identify the children with dyslexia. Interestingly, it is found that the children who make more errors in reading due to dyslexia also demonstrate slower reading speed. A study, conducted by Abu–Rabia and Taha (2004), among the children with dyslexia in comparison to reading–level–matched control group revealed that children with dyslexia demonstrate a higher rate of inaccurate pronunciation and omission of short vowels in word and nonword reading. Similarly, children with dyslexia exhibit higher rates of involuntary repetitions and omissions, poor phonological learning of new verbal information, poor word retrieval, and problems in rapid naming etc. Such problems including omissions, additions, substitutions, reversals etc also fall into the category of reading and spelling errors (Ramus et al, 2003; Vellutino et al., 2004; Szenkovists, & Ramus, 2005; Uppstad, & Tonnessen, 2007).

Misrepresentation of irregular sounds: Grapheme and phoneme level

Grapheme and phoneme sounds of a particular language seek more linguistic attention compared to regular words. Such sounds cannot be represented by straight grapheme-phoneme representations. Those irregular sounds represent extra obstacles to the children with dyslexia. They make relatively higher levels of reading errors than normal children when encountering such sounds (Schneider et al., 1997; Martin, Kronbichler, & Richlan, 2016). Lack of sufficient ability to establish the association between phonemes and graphemes representation exhibits reading impairments. Such sounds are not well grasped by children with dyslexia, which may also lead to problems in reading of non–words and recognition of pseudowords (Pavlidis, 1981b, Snowling, 2001a, 2001b; Ramus et al., 2003; Szenkovits, & Ramus, 2005; Martin, Kronbichler, & Richlan, 2016). When a child exhibits such signs, these should be considered as alarming risks of dyslexia and requires a formal assessment.

The aims were to: (i) identify children at the risk for dyslexia which might be considered as a general prevalence of dyslexia among Nepalese primary school children (ii) explore

a set of predictive variables in identifying children at the risk for dyslexia, and (iii) compare early grade reading skills of children at the risk for dyslexia with age and grade-matched control group.

Method and materials

The study used descriptive study design following positivist thought. Children at the risk were evaluated based on the logistic model of analysis. Thus, the observational data based on teachers' screening questionnaire and reading related performance were quantified and compared on group average.

Participants

In this study, children whose first language also was Nepali participated from five mainstream schools of Kathmandu valley, Nepal and the schools were selected by stratified sampling subdividing all schools into four geographical strata. One other mainstream school was purposely selected that was not included in the list of previously formed strata to serve as an age and grade-matched control group. The first four were selected to identify the risk cases and fifth one to compare the average of four with. The fifth school takes only those students who are at least average or above on intelligence and academic performance based on grade teachers' general screening. In the same way, out of twelve grade teachers, 11 females remaining male participated in screening. All participating teachers taught Nepali language in their schools, whereas they might teach additional subjects also. None of them had any prior exposure to the subject matter of learning disabilities and dyslexia, and to the methods of screening in the student population.

Eventually, 554 children, attending early grade education between grade 3 through 5, were screened. Recorded gender was boys 50.90% (n=282) and girls 49.10% (n=272) and their age ranged from 5:0-11:11 years (mean age=8:9, SD=1.76). This screening identified 75 children who exhibited most difficulties in one or more of four categories, like (i) reading performance and errors, (ii) spelling accuracy and errors, (iii) mathematical skills and difficulties, and (iv) behavioural problems. Among the 75 children identified at the screening stage, there were 48 (64%) boys and 27 (36%) girls, and their age ranged from 5:0- 11:11 years (mean age=9:2, SD=1:5). The fifth school chosen as the control group had 87 children and there were 45 (51.72%) boys and 42 (48.28%) girls. Their age ranged from 5;0 to 11;11 years (mean age=9;1, SD=1;5).

Materials

The test materials adapted here have been referred as the Pavlidis Test Set (PTS), developed by Prof. George Pavlidis ; the professor of the university of Macedonia, Greece, was utilised in this study. The materials were particularly well validated in the Greek population with learning disabilities; and its accuracy and usefulness were assured by subsequent studies in school age children of Greece, USA and England (Bakirtzis, 2005) showing overall greater than 97%. The PTS includes (i) teacher orientation material (TOM), (ii) teachers' screening questionnaire (for indirect assessment), (iii) reading materials for direct assessment. Furthermore, it also provides detailed guidelines for administering the test and analysing data.

Teachers' Orientation Material (TOM)

The teacher's orientation material (TOM) was adapted to orient the teachers of the participating schools to well understand the primary contributors in children's learning disabilities, namely (1) pedagogy originated, (2) disability originated, (3) IQ originated,

and the importance of grouping students accordingly for the betterment of school education system. Besides, Nepalese teachers particularly needed fresh awareness about learning disabilities (dyslexia) because we found that most of the Nepali teachers had very little knowledge about the impact of dyslexia in learning traits. Through this material, teachers become familiar with (i) reading performance and errors, (ii) spelling accuracy and errors, (iii) mathematical skills and difficulties, (iv) behavioural problems, and (v) dyslexia.

Teachers Screening Questionnaire (TSQ)

The teachers screening questionnaire (TSQ) consists of four general questions related to literacy difficulties and behavioural problems such as (i) oral reading difficulties, (ii) spelling difficulties, (iii) mathematical difficulties, (iv) behaviour problems. These areas of difficulties have been frequently exhibited by children with dyslexia (Von Aster, & Shalev, 2007; Carroll, Solity, & Shapiro, 2016). The participant teachers screened the children according to the TSQ that consists questions on a 5-points rating scale (i.e.,1 = does not have any problem, 2=small, 3=medium, 4=severe, 5=very severe). It was filled-up by the teachers based on the guidelines they had received through TOM and associated orientation and training on one hand and their knowledge about each and every student acquired through long term observation on them.

Reading Speed, Accuracy and Errors Test (RSAET)

Finally reading materials for direct assessment along with the reading speed, accuracy and error test (RSAET) consisted of a set of reading materials designed for a direct assessment of reading speed, accuracy and specific reading errors. It includes four different sets of text stories with raising the level of difficulties of words and phrases according to grade level providing reading stories is a functional and authentic way of assessing children's actual level of reading performance.

Procedure

Process of adapting the test materials

Data were collected from purposefully selected participants by using the test materials (i.e., PTS) as mentioned above while ethical consideration was addressed. The PTS test materials used in this research was originally in Greek language, however, we adapted into Nepali version as followed by Thapa, Okalidou, & Anasatasiadou (2016), firstly on the basis of word for word conversion method and secondly, free translation as a supplement method, was followed. Under this, texts were translated into target language (i.e., Nepali) based on their meaning and cultural use rather than its structure.

Teacher's orientation and training

Teacher's orientation and training meetings were organised during the data collection process in order to explain the purpose of this research for teacher participants. The key intention was to sensitise the teachers about dyslexia and enable them to identify at the risk children with aforementioned difficulties; solely for reliable assessment. It was assumed that in the least developing countries like Nepal where teachers are supposed not to be soundly familiar with reading related cognitive difficulties.

Rendering Teacher's Screening Questionnaire (TSQ) and Direct Assessment

Firstly, the TSQ was distributed to teachers, and it was collected after a day. Teachers observationally assessed their grade children using an indirect assessment procedure on reading and spelling performance, mathematical difficulties as well as behavioural problems of at-risk children. Secondly, the students who were identified at

screening stage showing either extra difficulty in reading, spelling, mathematical operations and behaviour problems, were undertaken for direct assessment, and it was administered by the researcher on an individual basis. There was no provision to give any feedback to the child regarding the accuracy of their reading and spelling response.

Data recording, coding and analysis

All readings were first recorded in audio format and then these were scored with numeric value of 1 for each word read as measurement unit for reading speed and similarly for each word correctly read for reading accuracy. Similar transcription was implied for error words where numeric value 1 was given for each error word read. In addition, sum of reading errors were estimated based on the sum of prespecified reading errors, i. e. hesitation, repetition of corrects, repetitions of errors, syllabication errors, substitutions, reversals, omissions, additions, mis-intonations, punctuation errors, point marks. Such specific reading errors were also scored with a value of 1 for each single reading error. An informed consent form was obtained from each teacher participants while a written assent was filled-up by each parent/ sibling of 70 cases (children) who participated in direct assessment.

Data and Statistical analysis

The framework for data analysis was adapted from previous studies which mostly concerned on identifying children with dyslexia. Hence, this study initially identified children who were reported struggling in basic literacy related tasks (reading, spelling, mathematics and behavioural problems) and counted in number and percentage as the rate of possible/initial at the risk children. Subsequently, the data were analised for identifying risk children using many prereading related parameters as mentioned in tools (i.e., RSAET) and these parameters were interacted for group differences and their predictive values. Statistical Package for the Social Sciences (SPSS), v. 21.0 was used for the analysis. Before carrying out the statistical analysis, the Kolmogorov–Smirnov test was conducted on the recorded statistical data in order to look for its goodness–of–fit. At the next stage, group difference was estimated using Mann–Whitney test for risk and control group, and homogeneity of the scores was tested using nonparametric Levene's test. Subsequently, the effect size between the two groups' mean ranks (r) was calculated using Z scores by square root of sum of participants' number (r=Z/square root of N), and the rules of thumb was used for categorization. We considered the effect as small size = 0.1, medium size = 0.3 and large size = 0.5. Additionally, logistic regression was generated in order to examine the group membership that differentiated false prediction or misclassification of cases. This was used for scores obtained by administering RSAET.

Results

Estimated at-risk children for dyslexia through teachers' screening

The results obtained through Teachers' screening showed that seventy-five children out of 554 were found having difficulties in either reading and/or spelling or mathematical problems or behavioural problems. Cases having reading difficulty and other associated problems are presented in Table 1 that shows single difficulty as well as co-occurrence. As a single difficulty, behavioural problems appeared to be the most frequent of all among the screened children. Occurrence of this problem was found to be 1.99%, followed by reading difficulties with 1.26%, spelling errors with 1.08% and the least frequent being mathematical difficulty with 0.09%.

The reading associated difficulties and problems were also estimated as co–occurrence (see Table 1). Here, the term co-occurrence refers to those potential cases

which persist with more than one difficulties and problems, not just a single difficulty mentioned above. In this regard, the most frequent difficulty associated with other problems was reading difficulty at 9.39% of the children, followed by 8.66% with spelling problems, then 4.33% with mathematical difficulties. Additionally, co-occurrence of behavioural problems was found to be 4.69%. Eventually, the occurrence of dyslexia was estimated from teachers' screening to be 13.54% (75 cases) among early grade children.

Table 1

The frequencies of the children with occurrence and co–occurrence of reading difficulty and related domains at screening stage

Type of difficulty	No. and percentage of occurrence	No. of co–occurrence
Reading	7 (1.26)	52 (9.39)
Spelling	6 (1.08)	48 (8.66)
Mathematics	5 (0.90)	24 (4.33)
Behavioural problems	11 (1.99)	26 (4.69)

The occurrence denotes those cases who were identified with single difficulty where co–occurrence does the cases with at least two difficulties or more. The percent cases for occurrence and co–occurrence were calculated based on the total children screened (n=554), and percentage in parenthesis.

Occurrence of children at-risk of dyslexia after direct assessment

Occurrence of dyslexia identified at screening stage was verified by direct assessment where cases were confirmed using a logistic regression analysis. This approach is considered to be appropriate for classifying the cases based on predictors. Hence, we accounted for reading speed, reading accuracy, total error words, sum of reading errors and a set of prespecified reading errors as the predictors. Thus, the final estimated children at risk of dyslexia was estimated to be 12.63% (70 cases) after corrected false cases by direct assessment while 5 false cases were found out of 75 identified at screening stage. In this regard, this can be considered as prevalence of dyslexia.

Logistic regression analysis for group membership and order of predictors

The overall Logistic Regression outcomes were found to be statistically significant. It showed that the predictors were reliable in distinguishing the risk group from the control [$\chi 2$ (df 11, N = 162) = *141.005*, $p<0.001$)]. Nagelkerke's 0.887 suggested that the model had a moderately strong relationship between prediction and grouping. Eventually, the overall accuracy rate of predictors was estimated to be approximately 92% (i.e., 91.89%) where a higher rate of accuracy (94.04%) was estimated predicting the control group than the risk one (89.74%) (Table 2). Based on the cut of value of 0.5, the sensitivity was 89.74% and specificity 94.04% indicating relatively stronger positive than negative predictive value (Table 2). In the classification of groups, syllabication errors, reading speed, repetition of errors and number of errored words were the order of most predictable variables where syllabication errors was the strongest predictor relevant to Nepalese early grade school children (–2Log Likelihood was significant with a value of 138.113) that classified the children at the risk for dyslexia and control groups with an overall 92.59% of accuracy. Following syllabication errors, the order of other predictors were reading speed (10.342), repetition of errors (6.124) and number of errored words (5.798) respectively.

Table 2

The observed and the predicted frequencies for reading difficulties by Logistic Regression

Classification Table[a]				
		Predicted		
	Group prediction			
Observed		**Risk group**	**Control group**	**Percentage correct**
Group	Risk group*	70	5	89.74
	Control group#	8	79	94.04
Overall percentage				91.89

**n=75, #n=87*

Note: a. The cut off value is 0.5, Omnibus Tests of Model Coefficients = [χ2 (11, N = 162) = 141.005, p<0.001)].

Sensitivity = 70/(70+8)×100=(0.8974)×100=89.74%

Specificity = 79/(79+5)×100= (0.9404)×100 = 94.04%

Positive Predictive Value (PPV) = 70/(70+5)×100, = 93.33%

Negative predictive value(NPV) = 79/(8+79)×100, = 90.80%

Formula for sensitivity, specificity, positive and negative prediction by Trevethan (2017)

As we used a logistic regression analysis to classify the correct cases and exclude false cases from participants of risk and control groups. The predictors were reading performance (i.e., speed and accuracy) and reading errors (see Table 3 & 4). Among these, the reading errors further depend on total error words, sum of reading errors and reading errors in prespecified categories. In this regard, only the variables that demonstrated significant difference between risk and control groups were used for regression analysis. They were reading speed, reading accuracy, total error words, sum of reading errors, syllabication errors, substitutions, repetition of errors, hesitation, omissions, punctuation errors and point marks errors as well as gender, age and grade (see Table 3 & 4). The Wald Criterion showed that hesitation, repetition of corrects, repetition of errors, syllabication errors, substitutions, reversals, omission, addition as well as the number of error words, total number of errors appeared as good predictors ($p<0.05$) that can correctly identify the risk cases of dyslexia. However, mis-intonation, punctuation error, point mark errors, reading speed and reading accuracy in both gender and all age categories appeared with less powerful predictors ($p>0.05$).

Table 3

Group comparisons on reading speed, accuracy, total error words and sum of reading errors measured per 100 words

Reading performance	**Reading groups***	**Mean rank**	**Sum of ranks**	**Sig.**
Reading speed	Risk group	52.15	3911.50	
	Control group	106.80	9291.50	<0.001
Reading accuracy	Risk group	51.91	3839.50	
	Control group	107.01	3909.50	<0.001
Total errored words	Risk group	96.84	7263.00	
	Control group	68.28	5940.00	<0.001
Sum of reading errors	Risk group	114.47	8585.50	
	Control group	53.07	4617.50	<0.001

**Risk group consists of 75 and control of 86 participants*

Group comparison on prereading skills

Reading speed and accuracy

For reading speed, a Mann–Whitney test revealed that there was a significant group difference; *U = 1065.500, Z= –7.394, p<0.001* with a strong effect size (the absolute value of r =0.58) where the values of mean ranks were 52.15 for risk group and 106.80 for control one (see Table 3). Nonparametric Levene's Test for homogeneity revealed that the assumption of homogeneity was met. This also revealed that the distributions seem approximately similar between groups [F(1,162) = 0.034, p>0.05]. Similarly, using a Mann–Whitney test for reading accuracy, it also resulted in a significant group difference; *U = 1043.500, Z= –7.455, p<0.001)* with a strong effect size (the absolute value of r =0.59) where mean ranks for both groups were 51.91 and 1107.01 respectively (Table 3). In addition, the homogeneity of distributions was estimated using Nonparametric Levene's Test that indicated there was no significant difference between the score distributions of both groups [F(1,162) = 0.072, p>0.05].

Total error words

Comparison of total error words between risk and control groups is presented in Table 3. Hence, a Mann–Whitney test revealed that the group difference was significant; *U = 2112.0, Z= –3.892, p<0.001* with a moderate effect size (the absolute value of r =0.31) indicating a larger value of mean rank for risk group (i.e., 96.84) than control one (i.e., 68.28). Such values were checked whether assumption of homogeneity was met or not, and Nonparametric Levene's Test was performed for this purpose. The results indicated that the distributions were approximately similar between groups [F(1,162) = 0.000, p>0.05].

Sum of reading errors

The prespecified reading errors were summed that indicated the risk group made significantly higher reading errors than the peers of the control group. A Mann–Whitney test revealed that the group difference was significant; *U = 789.5000, Z= –8.315, p<0.001* with a strong effect size (the absolute value of r =0.65) where the values of mean ranks were 114.47 for risk group and 53.07 for control one (Table 3). Furthermore, assumption of the homogeneity was estimated that indicated the distributions seem approximately similar between groups [F(1,162) = 0.953, p>0.05].

Subtypes of reading errors

The subcategories of reading errors were analysed on the basis of individual items of prespecified reading errors. Such errors were compared between the risk group and control group in order to confirm whether the group differences exist or not. A Mann–Whitney test has revealed that the participants of the risk group exhibited greater mean ranks on reading errors in most of the items compared to the peers of control group (Table 4). The results on each category were as follows: syllabication errors (*U* = 457.000, *Z*= –10.030, *p<0.001* with a strong effect size; the absolute value of r =0.79), substitutions (*U* = 1860.000, *Z*= –4.789, *p<0.001* with a medium effect size; the absolute value of r =0.38), repetition of errors (*U* = 1689.500, *Z*= –5.704, *p<0.001* with a medium effect size; the absolute value of r =0.49), hesitation (*U* = 1887.000, *Z*= –4.958, *p<0.001* with a medium effect size; the absolute value of r =0.39), omissions (*U* = 2615.000, *Z*= –2.246, *p<0.05* with a small effect size; the absolute value of r =0.18), punctuation errors (*U* = 2615.000, *Z*= –1.793, *p<0.05* with a small effect size; the absolute value of r =0.14), point marks errors (*U* = 3084.000, *Z*= –1.702, *p<0.05* with a small effect size; the absolute value of r =0.13).

Homogeneity test among the risk and groups indicated that the distributions of scores seem approximately similar between groups on two subcategories: substitutions [F(1,162) = 3.530, p>0.05] and repetition of errors [F(1,162) = 9.756, p>0.05]. On syllabication errors [F(1,162) = 12.366, p<0.05], hesitation [F(1,162) = 8.917, p<0.05], omissions [F(1,162) = 8.917, p<0.05], punctuation errors [F(1,162) = 13.768, p<0.05], and point marks errors [F(1,162) = 12.708, p<0.05], however, there was a much pronounced difference between the groups.

The mean rankings of selected subcategories of reading errors on risk and control groups were not found to be statistically different (Table 4). These subcategories were repetition of corrects(U = 2876.000, Z= –1.348, $p>0.05$), additions(U = 2843.000, Z= –1.475, $p>0.05$), mis-intonations U = 2871.500, Z= –1.609, $p>0.05$) and reversals (U = 6737.500, Z= –1.690, $p>0.05$). Of them, repetition of corrects [F(1,162) = 0.098, p>0.05], additions [F(1,162) = 1.458, p>0.05], mis-intonation [F(1,162) = 0.953, p>0.05] also constituted heterogeneous distributions. Reversals [F(1,162) = 9.368, p<0.05], however, demonstrated homogeneous distribution.

Table 4

Group comparisons on various subcategories of reading errors measured per 100 words

Subcategories of reading errors	Reading groups*	Mean rank	Sum of ranks	Sig.
Syllabication errors	Risk group	118.91	8918.00	
	Control group	49.25	4285.00	<0.001
Substitution	Risk group	100.20	7515.00	
	Control group	65.38	5688.00	<0.001
Repetition of errors	Risk group	102.47	7685.50	
	Control group	63.42	5517.50	<0.001
Hesitation	Risk group	99.84	7488.00	
	Control group	65.69	5715.00	<0.001
Omissions	Risk group	90.13	6760.00	
	Control group	74.06	6443.00	<0.05
Repetition of corrects	Risk group	86.65	6499.00	
	Control group	77.06	6704.00	>0.05
Additions	Risk group	87.09	6532.00	
	Control group	76.68	6671.00	>0.05
Mis-intonation	Risk group	86.71	6503.50	
	Control group	77.01	6699.50	>0.05
Reversals	Risk group	86.21	6465.50	
	Control group	77.44	6737.50	>0.05
Punctuation error	Risk group	85.73	6429.50	
	Control group	77.86	6773.50	<0.05
Point marks error	Risk group	79.12	5934.00	
	Control group	83.55	7269.00	<0.05

*Risk group consists of 75 participants and control of 86

Discussion

Overall results appeared in the line of previous studies. In particular, the results estimated from teachers' screening indicated that 13.54% of Nepalese early grade children are at high risk of dyslexia, but it was 12.63% after correcting false cases by direct assessment which might be considered as the general prevalence of dyslexia. It signifies the teachers' identification of risk cases that appeared to be highly accurate in this study. This results yields with the range indicated by the International Dyslexia Association (2006) that reported 20% of the population exhibits some form of learning disabilities, of which 85% are considered to be struggling with dyslexia, and Rao et al. (2013) revealed such occurrence to be 13.54%. The risk group exhibited significantly poor performance on reading speed and accuracy as compared to the peers of the control group. Whereas the study demonstrated a higher rate of reading errors such as total word errors, sum of reading errors and a set of prespecified reading errors. Overall logistic regression outcomes were found to be statistically significant indicating the predictors were reliable in group classification (i.e., risk and control groups).

Reading speed and accuracy

The present study showed that the children of the risk group were poorer in reading related tasks than their normal peers. Particularly, children of the risk group showed poorer reading speed and accuracy than the children of the control group (Table 3). This finding is supported by some previous studies. For example, Tressoldi, Stella and Faggella (2001) who found the children with dyslexia were poorer in the tasks than typical readers. Similarly, other studies also supported the present findings indicating that children with dyslexia exhibit relatively lower reading speed than normal children (Rayner et al., 2001; de Jong, & Van Der Leij, 2003). Serrano, & Defior (2008) also found that the participants with dyslexia were unable to compete with the control group in reading speed and accuracy. The children with dyslexia always face a challenge in reading speed and accuracy at par with the normal developmental stage. It occurs due to deficits in proper representation of phonemes even in an understandable pattern. Therefore, the struggle in phonological representations directly contributes to slow reading speed and accuracy (de Jong, & Van Der Leij, 2003).

Reading Errors

Both risk and control groups exhibited certain types of reading errors in terms of number of error words and sum of reading errors. However, it is found that the children of the risk group demonstrated significantly greater amounts of reading errors than the peers of the control group (Table 3 & 4). These types of reading errors occur due to difficulties in proper grapheme-phoneme correspondence of the particular orthography which children with dyslexia face more (Share, 1995). Thus, it leads readers to make plenty of reading errors. The findings of this study is supported by a study that indicated that children with dyslexia show a higher rate of dysphonetic errors than the children of the control group (Abu–Rabia, & Taha, 2004). Dysphonetic errors include mistakes in producing inaccurate pronunciation of words, omission of short vowels in words and nonwords which are considered to be the common source of reading errors. Errors in reading may occur due to inefficiency in some irregular graphemic–phonemic mappings and correspondence (Schneider et al., 1997). Children with dyslexia are dysfunctional in such tasks. In particular, repetition difficulties, lack of proper ability to identify the navigation between graphemes and phonemes patterns are common problems faced by children with dyslexia (Pavlidis, 1981a, Ramus et al, 2003; Szenkovits, & Ramus, 2005). In the present

study, such difficulties were demonstrated at a larger proportion by the children of the risk group.

Reading errors demonstrated by both risk and control groups were analysed by some specific subtypes. It has been revealed that the participants of the risk group demonstrated significantly greater amounts of reading errors on most of the specific subcategories of reading compared to the peers of the control group (Table 3 & 4). The findings of this study are similar to the previous studies that revealed significantly greater quantitative reading errors by dyslexic children compared to the peers of the control group (Crutch, 2006; Ziegler et al., 2008). Findings from a study carried out among 8;1–12;1–years–old children with dyslexia and age–matched normal indicated that the children with dyslexia exhibited higher amount of phoneme-matching type of errors measured through assessing initial and final position of phoneme matching tasks (Ziegler et al., 2008). It is argued that greater rate of reading errors like omissions, additions, substitutions, reversals etc. are demonstrated by dyslexics due to phonological deficits (see Ramus et al., 2003; Uppstad, & Tønnessen, 2007), but this notion is disregarded suggesting poor visual ability in discriminating and decoding regular as well as irregular or pseudo phonemes cause reading errors (Pavlidis, 1985; Schumacher et. al., 2007).

Conclusion

The study aimed at identifying children at the risk for dyslexia which might be considered as a general prevalence of dyslexia among early grade Nepalese primary school children. It identified at-risk children using prereading skills indicating approximately 13%. They were prone to exhibited significantly poor prereading skills and made significant errors in reading related tasks compared to their control peers. The findings signified the teachers' screening in identifying the risk cases of dyslexia since their evaluation was verified by direct assessment. Based on assessments by both teachers and direct assessment, the results appeared with an accuracy of 92.59% in identifying the true risk cases of dyslexia as the predictive variables performed by logistic regression. Though, it is suggested that teachers' screening must be improved by administering other supplemental tests. The findings of this study are consistent to the previous studies aimed at estimating prevalence of dyslexia. We highlight a need for full-fledged diagnostic studies which measure also intellectual and cognitive related abilities. Furthermore, we confirmed that syllabication errors, reading speed, repetition of errors and number of error words were the best predictors of cases at the risk of dyslexia. The findings of this study may have many implications on various ways. Teachers and practitioners may make initial referrals for further assessment of those repeatedly make syllabication errors, lower reading speed, repetition of errors and number of error words. Similarly, it would be useful on initiating policy of early identification and intervention in a timely manner to prevent the children from irreparable damages. Findings also signify the importance of educational responses in an inclusive manner. Consequently, children at the risk of dyslexia may be also benefited from general classroom instruction and widens the social participation.

Delimitations and Directions for Future Initiations

This study extends the preliminary data presented by Thapa (2018). The participants were assessed following indirect to direct assessment using teacher's screening and employing grade appropriate reading tasks that were particularly well validated in the

Greek population. The test materials used in this study were not enough to cover the entire components of dyslexia assessment. Thus, it is suggested that additional tests could be developed and employed in further studies in order to provide more information and statistics about cognitive characteristics since poor cognitive abilities are strongly associated with dyslexia. In addition, this study did not administer any formal IQ related assessment due to the lack of standardised IQ tests available in Nepali language and cultural context. Thus, a full-phased assessment is suggested for further study and more valid and reliable results.

Acknowledgement

The author would like to express his sincere gratitude to all participating schools, teachers and children who made this study possible by providing relevant data. Special thanks go to Prof. George Th. Pavlidis who provided his intellectual properties, particularly assessment tools to adapt in Nepalese context without any cost and conditions. In addition, the author also express his gratitude to Prof. George Th. Pavlidis and Prof. Areti Okalidou for personal and professional guidance and taught me a great deal about both scientific research and life in general. Likewise, the author would like to offer his gratitude to the State Scholarship Foundation (IKY), Greece for financial support. Next, Dr. Pramod Dhakal is also highly acknowledged for his generous support during the preparation of this manuscript.

Reference

Abu-Rabia, S., & Taha, H. (2004). Reading and spelling error analysis of native Arabic dyslexic readers. *Reading and Writing, 17*(7-8), 651-690. https://doi.org/10.1007/s11145-004-2657-x

Al-Lamki, L. M. (2012). Dyslexia: Its impact on the Individual, Parents and Society. *Sultan Qaboos University medical journal,12*(3), 269–72. DOI: 10.12816/0003139

Bailey, A. L., & Drummond, K. V. (2006). Who is at the risk and why? Teachers' reasons for concern and their understanding and assessment of early literacy. *Educational Assessment, 11*, 149–178. https://doi.org/10.1080/10627197.2006.9652988

Bailey, A. L., Cano, L., Fischer, D., Freeman, S., Jacobs, J., Heritage, M., et al. (2001). *The LDC manual: A guide to using the Literacy Development Checklist* (Rev. ed.). Los Angeles: University of California Regents.

Bakirtzis, K. (2005). *The Quantitative and Qualitative Differences in the Reading Ability Between Pupils with Mild Mental Retardation and Age Matched Normal Pupils* (Unpublished M.Phil. Thesis). Brunel University, England.

Beswick, J. F., Willms, J. D., & Sloat, E. A. (2005). A comparative study of teacher ratings of emergent literacy skills and student performance on a standardized measure. *Education, 126*(1), 116–138. https://eric.ed.gov/?id=EJ725163

Carroll, J. M., Solity, J., & Shapiro, L. R. (2016). Predicting dyslexia using prereading skills: the role of sensorimotor and cognitive abilities. *Journal of Child Psychology and Psychiatry, 57*(6), 750-758. DOI: 10.1111/jcpp.12488

Catts et al. (2015). Early identification of reading disabilities within an RTI framework. *Journal of Learning Disabilities, 48*(3), 281–297. DOI: 10.1177/0022219413498115

Compton, et al. (2010). Selecting at-risk first grade readers for early intervention:

Eliminating false positives and exploring the promise of a two-stage gated screening process. *Journal of Educational Psychology, 102*(2), 327–340. DOI: 10.1037/a0018448

Crutch, S. J. (2006). Qualitatively different semantic representations for abstract and concrete words: Further evidence from the semantic reading errors of deep dyslexic patients. *Neurocase, 12*(2), 91-97. https://doi.org/10.1080/13554790500507172

Davis, N., Lindo, E. J., & Campton, D. D. (2007). Children at the risk for reading failure: Constructing an early screening Measure. *Teaching Exceptional Children, 39*(5), 32–37. https://doi.org/10.1177/004005990703900

de Jong, P. F., & Van Der Leij, A. (2003). Developmental changes in the manifestation of a phonological deficit in dyslexic children learning to read a regular orthography. *Journal of Educational Psychology, 95*, 22–40. https://doi.org/10.1037/0022-0663.95.1.22

Deno, S. L. (2003). Developments in curriculum-based measurement. *The Journal of Special Education, 37*, 184–192. https://doi.org/10.1177/00224669030370030801

Goswami, U. (2015). Sensory theories of developmental dyslexia: three challenges for research. *Nature Reviews Neuroscience, 16*(1), 43-54. DOI: 10.1038/nrn3836

Ho, C. S. H., Chan, D. W. O., Tsang, S. M., & Lee, S. H. (2002). The cognitive profile and multiple-deficit hypothesis in Chinese developmental dyslexia. *Developmental Psychology, 38*(4), 543-153. DOI: 10.1037//0012-1649.38.4.543

Hulme, C., & Snowling, M. J. (2013). Learning to read: What we know and what we need to understand better. *Child development perspectives, 7*(1), 1-5. DOI: 10.1111/cdep.12005

Jenkins, J. R., Hudson, R. F., & Johnson, E. S. (2007). Screening for at-risk readers in a response to intervention framework. *School Psychology Review, 36*(4), 582–600. https://doi.org/10.1080/02796015.2007.12087919

Johnson, E. S., Jenkins, J. R., Petscher, Y., & Catts, H. W. (2009). How can we improve the accuracy of screening instruments? *Learning Disabilities Research and Practice, 24*(4), 174–185. https://doi.org/10.1111/j.1540-5826.2009.00291.x

Lee, L. W. (2007). Development and Valfvidation of a Reading-related Assessment Battery in Malaya for the Purpose of Dyslexia Assessment. *Annals of Dyslexia, 58*, 37-58. DOI: 10.1007/s11881-007-0011-0

Madelaine, A., & Wheldall, K. (2005). Identifying low-progress readers: Comparing teacher judgement with a curriculum-based measurement procedure. *International Journal of Disability, Development and Education, 52*, 33–42. https://doi.org/10.1080/10349120500071886

Martin, A., Kronbichler, M., & Richlan, F. (2016). Dyslexic brain activation abnormalities in deep and shallow orthographies: A meta-analysis of 28 functional neuroimaging studies. *Human Brain Mapping, 37*(7): 2676–2699. DOI: 10.1002/hbm.23202

Ministry of Education (2014). Country Report on Early Grade Reading Skills Assessment. Kathmandu: USAID Nepal. Retrieved on 23 Jan. 2022 from: https://www.moe.gov.np/assets/uploads/files/NEGRP_Final_Document.pdf

MoE (2018). *Education in Figures 2017 (At A Glance)*. Kathmandu: Ministry of Education, Science & Technology, Kathmandu, Nepal.

Pavlidis, G. Th. (1981a). Do eye movements hold the key to dyslexia? *Neuropsychologia, 19*, 57-64. https://doi.org/10.1016/0028-3932(81)90044-0

Pavlidis, G. Th. (1985). Eye movements in dyslexia have diagnostic significance. *Journal of learning disabilities, 18*(1), 42-50. https://doi.org/10.1177/002221948501800109

Puolakanaho, A., Ahonen, T., Aro, M., Eklund, K., Leppanen, P. H. T., Poikkeus, A.-M., & Lyytinen, H. (2007). Very early phonological and language skills: estimating individual risk of reading disability. *Journal of Child Psychology and Psychiatry, 48*(9), 923–931. DOI: 10.1111/j.1469-7610.2007.01763.x

Ramus, F., Rosen, S., Dakin, S. C., Day, B. L., Castellote, J. M., White, S., & Frith, U. (2003). Theories of developmental dyslexia: insights from a multiple case study of dyslexic adults. *Brain, 126*(4), 841-865. https://doi.org/10.1093/brain/awg076

Rao, S., Raj, A., Ramanathan, V., Sharma, A., Dhar, M., Thatkar, P. V., & Pal, R. (2017). Prevalence of dyslexia among school children in Mysore. International *Journal of Medical Science and Public Health. 6*(1), 159-164. DOI: 10.5455/ijmsph.2017.05082016592

Rayner, K., Foorman, B. R., Perfetti, C. A., Pesetsky, D., & Seidenberg, M. S. (2001). How psychological science informs the teaching of reading. *Psychological Science in the Public Interest, 2*, 31–74. https://doi.org/10.1111/1529-1006.00004

Regmi, N. P. (2017). *Inclusive Education in Nepal: From Theory to Practice* (Unpublished Thesis). Ludwig-Maximilians-University, Munich, Germany.

Schneider, W., Kuspert, P., Roth, E., Vise, M., & Marx, H. (1997). Short-and long-term effects of training phonological awareness in kindergarten: Evidence from two German studies. *Journal of Experimental Child Psychology, 66*, 311–340. DOI: 10.1006/jecp.1997.2384

Schumacher, J., Hoffmann, P., Schmäl, C., Schulte-Körne, G., & Nöthen, M. M. (2007). Genetics of dyslexia: The evolving landscape. *Journal of medical genetics, 44*(5), 289-297. DOI: 10.1136/jmg.2006.046516

Serrano, F., & Defior, S. (2008). Dyslexia speed problems in a transparent orthography. *Annals of dyslexia, 58*(1), 81-95. DOI: 10.1007/s11881-008-0013-6

Share, D. L. (1995). Phonological recoding and self-teaching: Sine qua non of reading acquisition. *Cognition, 55*, 151–218. DOI: 10.1016/0010-0277(94)00645-2

Snowling, M. J. (2001a). From language to reading and dyslexia. *Dyslexia, 7*(1), 37-46. DOI: 10.1002/dys.185

Snowling, M. J. (2001b). Developmental dyslexia. *Current Paediatrics, 11*, 1013. https://doi.org/10.1054/cupe.2000.0135

Soodla, P., & Kikas, E. (2010). *Teachers' judgement of students' reading difficulties and factors related to its accuracy*. In A. Toomela (Ed.),Systemic Person-Oriented Study of Child Development in Early Primary School (pp. 73–94). Pieterlen: Peter Lang

Stecker, P. M., Fuchs, L. S., & Fuchs, D. (2005). Using curriculum-based measurement to

improve student achievement: Review of research. *Psychology in the Schools, 42*(8), 795–819. https://doi.org/10.1002/pits.20113

Sudkamp, A., Kaiser, J., & Moller, J. (2012). Accuracy of teachers' judgments of students' academic achievement: A meta-analysis. *Journal of Educational Psychology, 104*(3), 743–762. https://doi.org/10.1037/a0027627

Szenkovists, G., & Ramus, F. (2005). Exploring dyslexics' phonological deficit I: Lexical vs. sub-lexical and input vs. output processes. *Dyslexia, 11*, 253– 268. DOI: 10.1002/dys.308

Thapa, K. B. (2018). Preliminary scenario of dyslexia among Nepalese primary school children. *Participation, 20*(18), 113-119.

Thapa, K. B., Okalidou, A., & Anasatasiadou, S. (2016). Teachers' screening estimations of speech–language impairments in primary school children in Nepal. *International Journal of Language and Communication Disorders, 51*(3):310-327. DOI: 10.1111/1460-6984.12209

Thompson, P. A.; Hulme, C.; Nash, H. M.; Gooch, D.; Hayiou-Thomas, E.; Snowling, M. J. (2015). Developmental dyslexia: predicting individual risk. *J. Exp. Child Psychol, 56*, 976–987. DOI: 10.1111/jcpp.12412

Tressoldi, P. E., Stella, G., & Faggella, M. (2001). The development of reading speed in Italians with dyslexia: A longitudinal study. *Journal of learning disabilities, 34*(5), 414-417. DOI: 10.1177/002221940103400503

Trevethan, R. (2017). Sensitivity, specificity, and predictive values: foundations, pliabilities, and pitfalls in research and practice. *Front. Public Health*, 5:307. DOI: 10.3389/fpubh.2017.00307

Uppstad, P. H., & Tønnessen, F. E. (2007). The notion of 'phonology' in dyslexia research: cognitivism—and Beyond. *Dyslexia, 13*(3), 154-174. DOI: 10.1002/dys.332

USAID (2014). USAID'S early grade reading program (EGRP) in Nepal. USAID, Kathmandu, Nepal. Retrieved on 22 Jan. 2022 from: https://www.usaid.gov/sites/default/files/documents/1861/Nepal_EGRP-Fact-Sheet_FINAL.pdf

Vellutino, F. R., Fletcher, J. M., Snowling, M. J., & Scanlon, D. M. (2004). Specific reading disability (dyslexia): what have we learned in the past four decades? *Journal of child psychology and psychiatry, 45*(1), 2-40. DOI: 10.1046/j.0021-9630.2003.00305.x

Von Aster, M. G., & Shalev, R. S. (2007). Number development and developmental dyscalculia. *Developmental medicine & child neurology, 49*(11), 868-873. DOI: 10.1111/j.1469-8749.2007.00868.x

Zabell, C., & Everatt, J. (2000). Surface and phonological subtypes of adult developmental dyslexia. *Dyslexia, 8*, 160–177. DOI: 10.1002/dys.223

Ziegler, J. C. (2006). Do differences in activation challenge universal theories of dyslexia? *Brain and language, 98*, 341-343. DOI: 10.1016/j.bandl.2005.05.002

Ziegler, J. C., Castel, C., Pech-Georgel, C., George, F., Alario, F. X., & Perry, C. (2008). Developmental dyslexia and the dual route model of reading: Simulating individual differences and subtypes. *Cognition, 107*(1), 151-178. DOI: 10.1016/j.cognition.2007.09.004

Zumeta, R. O., Compton, D. L., & Fuchs, L. S. (2012). Using word identification fluency to monitor first-grade reading development. *Exceptional Children, 78*(2), 210–220. DOI: 10.1177/001440291207800204