Spelling Accuracy of Students with Visual Impairments: Suggestions based on Assistive Technologies

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ABSTRACT

One of the most significant goals of the dual curriculum for students who are visually impaired is the acquisition of braille literacy skills, which includes reading readiness, braille reading instruction and writing skills. The braille code is a tactile code of raised dots that enables individuals with visual impairment to access information through touch. Spelling is a fundamental component of literacy, while accuracy is regarded to be one of the prevalent goals of literacy. The present study investigates braille spelling accuracy in 55 Greek students with visual impairment in relation to students' type of blindness, level of education and educational setting, via a standardized test. Students in secondary education and students with total blindness gave more correct answers, whereas no significant correlation was found between braille spelling accuracy and educational setting. At the end of this paper practical instructional guidelines in conjunction with the use of technology are proposed, in order for students with visual impairment to improve braille accuracy in spelling.

Keywords: *Braille*, *spelling accuracy*, *visual impairment*

1. INTRODUCTION

It is widely accepted that the curriculum which best serves the educational needs of students who are visually impaired, consists of two major components (dual curriculum): instruction in traditional academic areas (reading, mathematics, social studies, science, language arts) and instruction in disability-specific skills (expanded core curriculum) [1]. The expanded core curriculum (ECC) encompasses skills in areas fundamental to students' ability such as braille literacy, social interaction skills, recreation and leisure, use of assistive technology, orientation and mobility, independent living, career education and visual efficiency training [2]. Both components of the dual curriculum require adequate time to teach, while their importance does not diminish with age or competency [3]. It is expected that students with visual impairment should be apt to master proficiently both curricula [4].

One of the most significant goals of the ECC for students who are visually impaired is the acquisition of braille literacy skills, which includes reading readiness, braille reading instruction and writing skills [5]. The mastery of these skills presupposes a systematic involvement in the mechanics of braille reading and writing [5]. The mastery of high-level literacy skills seems to be significantly affected by motivation, which students with visual impairment receive from school as well as from their family environment [6]. It is expected that the acquisition of such skills will help students with visual impairment to consolidate positive attitude towards literacy and in turn getting them to participate more in class [7].

Several studies confirm that the responsibility for teaching braille literacy skills is mostly assigned to specialized teachers or/and to the collaboration between the special education teacher and the teacher of the class [6]. Initially the instruction of braille reading and writing skills is fully adjusted to the blind student's needs and interests and it might differ a lot from the instruction that a sighted child receives in order to develop his/her own literacy skills. Thus, a student who is visually impaired needs consistent and organized instruction [8] as well as additional instructional time [7] in order to develop and acquire braille literacy skills. However, it seems that the extra instructional time, which is absolutely justified within the context of the ECC, is not available in the context of educational mainstream settings [4].

Braille writing is feasible through a tactile code of raised dots that enables individuals with low or no vision to access information by touch. Its fundamental element is the braille cell, which consists of six raised dots distributed into the scheme of two columns and three rows. The pattern of the raised dots creates a total of 63 distinct combinations indicating an alphabet letter, a numeral or a punctuation mark. For the time being, there is a small piece of information about the mechanical and conceptual process of how young blind students learn to write, particularly during the early elementary years [9]. Students with visual impairment are expected to use the same cognitive processes with their sighted peers during writing tasks [10]. As for the mechanical process, characters are initially stored as shapes (i.e. schemata) in students' mind [11]. In turn, when students write braille through a brailler or through a braille note taker, these shapes (schemata) are retrieved and rendered by specific finger movements [12]. In parallel, grammar and

punctuation rules need to be mastered as well, in addition to the cognitive skills of organizing topics and selecting vocabulary [13].

Spelling is a fundamental component of literacy. Learning to spell enhances phonological awareness, word recognition, vocabulary and writing fluency [14]. Students with visual impairment initially rely on their acoustic and haptic experiences and they develop their spelling knowledge, when they begin to recognize braille letters gradually [10]. Few studies that have focused on spelling skills investigated solely the performance of students who were at the mid-elementary school level or above that [9]. Spelling skills of students who were visually impaired were found to be similar to sighted students' skills when spelling individual words [15, 16, 17] or words within the context of a text [10]. On the other hand, Arter (1997) claimed that sighted children are able to achieve higher levels of accuracy in spelling compared with the performances of their peers who are visually impaired, because it seems that the images of many words are imprinted on their memory and many of sighted children know to read and write before they start school [18].

Over the last years, spelling errors when writing braille were linked to: (a) problems with the braille code itself, (b) students' failure to master the braille code or/and (c) students' competence in spelling [19]. Students with visual impairment are likely to be deficient in memorizing the rules and irregularities of a complex written language, just like their sighted peers [9]. This may be more valid predominantly to elementary school students with visual impairment [11]. Moreover, it should be taken into account the restriction or exclusion that children with blindness experience from a rich of data environment such as random exposure to texts, labels or billboards [20, 21]. This incapacity may create a vicious circle: the less somebody reads the less somebody practices writing, which results in poor spelling. Furthermore, it has been reported that students with visual impairment, usually do not learn to read and write before entering school [18]. Additionally, students with low achievements were found to dislike braille reading, which influenced negatively their general literacy progress. Low-achievers were more likely to have limited vocabulary and inadequate braille literacy and spelling skills [6]. On the other hand, the heavy workload of senior students (college/ lyceum) often leads them to aural reading. Consequently, senior students do not practice braille and as a result their braille literacy skills fade [11]. Finally, spelling errors may result from typing errors such as misplaced key strokes [22].

Argyropoulos and Martos (2006) conducted a detailed qualitative and quantitative mapping of spelling errors of 16 Greek students who were visually impaired [11]. All errors were categorized into phonological (PT) and non-phonological types (NPT) that met the peculiarities of the Greek language. The students' performance was highly accurate. The elementary school students made more PT and NPT errors. The PT type-errors that the elementary students did were attributed to inexperience towards spelling. However, the most important finding was that the lyceum students made more PT and HT (historical type) errors than the high school students did. This finding may suggest that the increase in aural reading by students who are blind may minimize the degree of consolidation of the shapes in the mind (schemata) [11].

The research aim of this study was to assess braille spelling accuracy of blind students on the basis of type of blindness (congenitally vs adventitious), level of education (primary vs secondary) and predominantly educational setting, where braille literacy was taught (special or mainstream setting). The latter variable is of great importance, in order to determine where the literacy skills in the frame of the EEC are best implemented.

2. METHOD

2.1. Participants

55 Greek students with total and partial blindness participated in the present study (27 boys and 28 girls). The sample was characterized representative because the students were from several parts of Greece. Average age was 13.8 years, with a standard deviation of 3.9 years. Of all participants 33 (60%) were totally blind. Further, 29 (52.7%) were in secondary education. Finally, 34 (61.8%) were taught braille in special primary schools. Table 1 presents the distribution of participants based on gender, degree of blindness, educational level, and age at loss of vision.

2.2. Instrument

The selected research tool in our study was the standardized Inventory of Listing and Analyzing Spelling Errors [23], which evaluates spelling accuracy in Greek language. The test consists of 60 words and contains not only words that follow the basic grammar rules of the Greek language but irregularities as well. For example, in the Greek language, nouns are divided into three genders. The basic suffix of the nouns that belong to the neuter gender is '*ι*' (e.g. το φιλ*ί*), whereas the word 'το δίχτ*υ*' is exceptionally written with '*υ*'. The original form of the research tool was designed and standardized for sighted students, and the authors made all appropriate alterations to adapt it into the Greek braille code. Greek braille code consists of sixty three characters, out of which seven are called diphthongs and combine two vowels in one [11]. Accent was not taken into account, since it is not used in the Greek braille system.

2.3. Procedure

Initially each participant was given a blank sheet and a brailler. The researcher read each word separately. In turn, he read a short sentence that included the word in question and then he read the word again, in order to eliminate any misunderstandings regarding the meaning of the word. Then, the researcher asked the student to write down the word in braille. This procedure was

carried on for all words of the test. If a student performed six sequential mistakes, then the procedure was terminated [23].

		Gender		
		Girls	Boys	Total
Degree of Blindness	Total	19	14	33
	Partial	9	13	22
Educational Level	Primary	13	13	26
	Secondary	15	14	29
Educational Setting	Typical Primary	10	11	21
	Special Primary	18	16	34
Total		28	27	55

Table 1 Distribution of participants based on gender, degree of blindness, educational level, and educational setting where students were taught braille.

3. RESULTS

As mentioned above, the standardized Inventory of Listing and Analyzing Spelling Errors consisted of 60 words in total [23]. The average number of the correct spelled words in the spelling test, for the whole sample, was 33.64, with a standard deviation of 15.36 correct spelled words. The minimum number of correct spelled words was 3 and the maximum 59. Table 2 presents the average number of correct spelled words according to level of education, degree of blindness, and educational setting, where students were taught Braille.

Students in secondary education spelled more words accurately than students in primary education did ($t(53)=2.61$, $p<.05$), while students with total blindness spelled more words accurately than students with partial blindness ($t(53)=2$, $p=.05$). No significant correlation emerged between braille spelling accuracy and the educational setting.

4. DISCUSSION

The performance of 55 Greek students with visual impairment in braille spelling accuracy was examined in relation to students' degree of vision loss, school grade and educational setting, where braille literacy was taught. In total, congenitally blind students in secondary education and students who were taught braille in special primary schools performed better on average. More specifically, students in secondary education spelled more accurately than students in primary education, which subscribes to the results of Argyropoulos and Martos (2006) [11]. This result indicates that maturity, vocabulary enrichment via reading experience, repetitive instruction of the grammatical rules and irregularities [9], daily practice on writing and literacy skills, in general [24], are likely to ensure enhanced spelling skills in the course of time. Additionally, students with total blindness spelled more accurately than students with residual vision. This may be due to the fact that students with total blindness may use braille as a unique writing medium from the beginning of their schooling. Hence, they are more unlikely to perform typing errors [22] or errors linked to the braille code [19], in comparison to the partially sighted students. Finally, it is noteworthy to mention that no significant correlation emerged between braille spelling accuracy and the educational setting, where the students with visual impairment learnt the braille code. As a result the authors could not figure out in which educational setting spelling instruction was best implemented.

	N	M	SD
Level of Education			
Primary	26	28.27	12.66
Secondary	29	38.45	16.17
Degree of Blindness			
Total	33	36.91	15.2
Partial	22	28.73	14.59
Educational Setting Where Students Were Taught Braille			
Typical Primary School	21	31.71	13.6
Special Primary School	34	34.82	16.44

Table 2 Average number of correct spelled words in the spelling test according to educational level, degree of blindness and type of setting within which students learnt braille.

To conclude, this study aimed at assessing the braille spelling skills in order to propose practical instructional solutions with the use of technology, which could improve the spelling accuracy. Assistive technology in educational settings could be a component of the EEC, in order to improve braille spelling accuracy of children with visual impairments through autocorrect. Nowadays, the most common application of autocorrect is the Word-speller, which marks the misspelled words and gives the opportunity to the user to correct himself and, hence, to improve his/her spelling skills. Similarly, the low-cost 'Braille Writing Tutor (BWT)'aims at increasing braille literacy of the students with visual

impairment and provides guided practice using audio feedback for young children learning to write braille [25]. Finally, AVoS is an auditory vocabulary and spelling trainer, which helps the students with visual impairment to study foreign languages. Actually, it highlights orthographical errors through means of prosodic enhancement [26]. Future studies should involve the use of technology in order to promote student independence in academic, social, and independent living skills [27].

More evidence-based research on braille literacy programs is needed to guide teachers who teach students with visual impairment such as: a. to develop all the necessary skills for employment, happiness [11] and eventually independence [3], b. to identify strategies that develop positive academic behaviours (e.g. study skills) and, c. and to adopt effective instruction for students with visual impairment, based for example on applied behaviour analysis [27] or direct instruction [24]. Specialized skills, such as visual efficiency, tactile readiness, and the use of literacy tools (braille and technological devices), also need to be addressed [11]. All these skills are essential prerequisites for youths to face challenges in the transition from school to adult life [28].

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