

Undergraduate Student Education Programs Regarding Braille Literacy: A Transnational Comparative Study

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Abstract

Developing braille literacy skills represents one of the major goals of the education process for students with vision impairment. Fluency and accuracy in reading and writing facilitate access to information, development of knowledge, active participation, functionality, and independence in social contexts. One of the essential factors that can influence the success in the learning process of the braille code consists of the competences of teachers of students with vision impairment who teach braille. The purpose of this study was to investigate the reflections of 95 undergraduate special education students on their training programs regarding braille in their role as future special education teachers. Data were obtained through questionnaires which were administered in two departments of special education in two European universities. The results reported upon undergraduate students' reflections on their study in braille and confidence in teaching braille to students who are blind. The findings highlighted the need for further training into the braille code in conjunction with its literary and scientific notation.

Keywords: braille, students with vision impairment, tertiary education, undergraduate students

1. Introduction

Braille code is a tactile code through which individuals with severe vision impairments can read and write and become literate, according to conventional concepts of literacy (Schroeder, 1989; Stephens, 1989). However, recent researches have shown a decrease in the number of people with vision impairments that know to read and write braille. Braille illiteracy has been discussed intensively by many professionals the last decades. According to Wittenstein (1994) and Kleege (2006) in the U.S.A., there has been a nationwide decline in braille literacy. Also, according to Schroeder (cited in Kleege, 2006), braille literacy has declined from 51% to 9% during the years 1963-1993. In 2007 from the approximately 57 696 legally blind school-age children in the U.S.A., only 10% were using braille as their primary reading medium (American Printing House for the Blind, 2008). Wormsley (2011) presented that in 2006 in the U.S.A., 64% of the children who were visually impaired were not reading either print or braille while Australian researchers have lighted the same phenomenon a couple of decades ago (Gale, 2001) that braille literacy has declined significantly and is now at a critically low level worldwide. The National Federation of the Blind (2009) also confirms the same and it seems that this "braille illiteracy" phenomenon has acquired nowadays global qualities (Keil, 2012 in Roe et al., 2014; Penava, Prcić, & Ilić, 2017; Vernon, 2017).

Many researchers noted the phenomenon of braille illiteracy and tried to provide possible explanations for its existence and evolution. Schroeder (1989), Wittenstein (1994) and Johnston (2004) locate braille illiteracy to the decline in teachers' knowledge in braille. Teachers have been "accused" for incompetence in braille instruction (Eldridge, 1979; Mauer, Pierce (as cited in Wittenstein, 1994); Spungin, 1989; Stephens, 1989). According to Spungin (1989) "Blind children are not being taught braille because the teachers who are supposedly trained to do so themselves do not know the braille codes sufficiently" (p. 42). Spungin (1989) and Mullen (1990) brought forward the inadequate and inconsistent university braille teaching programs as the main cause of teachers' poor braille skills. Additionally, the increase of braille decline may be attributed to the un-orchestrating learning and use of assistive technology such as the increased use of synthetic speech at the expense of braille reading (Amato,

2002; Argyropoulos, Padeliadu, Avramidis, Tsiakali, & Nikolarazi, 2019; Goudiras, Papadopoulos, Koutsoklenis, Papageorgiou & Stergiou, 2009; Spungin, 1996; Sullivan, 1996). In addition, lack of positive attitudes toward braille and lack of qualified teachers may also be considered as potential indicators of braille decline (Amato, 2009; Mullen, 1991; Spungin, 1989; Willoughby & Duffy, 1989). Therefore, there has been a debate on how to make braille more attractive and how to motivate teachers - who are supposedly trained to do so - get more involved in teaching braille (Arnold, 2004). In addition, there is an on-going argument about the necessity of learning braille, since there are so many technological advances in the area of assistive technology for people who have vision impairment (Argyropoulos & Ravenscroft, 2019) which have influenced significantly conventional notions of literacy. These technological advances include multiple and alternate ways of transmitting information in order to address the diverse and unique needs of persons with sensory needs such as deafness or/and blindness (Luckner, Bruce, & Ferrell, 2016; McKenzie, 2009; Rupp, Gaffney, & Dymond, 2015).

Wittenstein (1993) found through his research that teachers whose education emphasized on instructions and/or practice in teaching braille were more likely to hold positive views on teaching braille than those whose education was concentrated on the knowledge of the braille code alone. During 1991-92, Wittenstein (1994) investigated the braille training experiences of 1 663 teachers of students who were visually impaired. Based on the results, the majority of the teachers were confident about their skills regarding braille but also stated that more information regarding braille instruction should have been included in their training, putting emphasis on the lack of training regarding the Nemeth code (i. e. is a braille code for encoding mathematical and scientific notation linearly using standard six-dot braille cells for tactile reading by individuals with vision impairment). Wittenstein and Pardee (1996) stated that training teachers only the braille code does not necessarily prepare them to develop literacy skills in their blind students. Teachers whose education involved braille literacy when participated in surveys stated that more direct instructional programs are needed for braille teaching (Argyropoulos, Katsoulis, & Eliadou, 2007; Johnston, 2004).

From the above, it can be argued that braille decline may stem from a synthesis of mutually dependent factors. These factors may refer to the a. undeveloped range of technological skills that students may have in order to allow them to choose the solution that best meets the demands of literacy tasks (McCall, McLinden, & Douglas, 2011), b. lack of systematic and up-to-date braille training, c. lack of teachers' motives in learning braille, and d. interpretation of braille as a simple code and not as a medium which has special weight in literacy and communication amongst people with little or no vision or no vision coupled with other sensory disability (such as deafblindness, see Argyropoulos, Nikolarazi, & Papazafiri, n.d.). Although the majority of data regarding direct instruction in braille and other literacy skills is pertinent to qualified teachers, the present study is focused on undergraduate students' higher education studies (universities, colleges) regarding braille literacy. As mentioned above, teachers should be appropriately prepared and educated in order to teach braille effectively to their students using all appropriate technological relevant advances. Thus, the authors of this study hold the view that the gravity of the content of braille instruction falls within undergraduate students' theoretical background and practical experience regarding braille literacy. Nevertheless, this kind of braille instruction seems to differ from one organization to another because, as Caton stated (1991), there are no quality standards for teaching braille in colleges and universities and no refresher courses available after graduation take place.

The main aim of the present study is to compare undergraduate students' education programs regarding braille literacy in two European countries (Romania and Greece). This comparison aimed to reveal similarities or/and differences in investigating undergraduate students' voices regarding this training.

2. The Romanian and Greek Content of Braille Instruction in Tertiary Education

2.1 Romanian Context and Content

In Romania, in order to be a teacher for the visually impaired, you need to get a certificate as special education teacher in accredited university programs and then improve your competences within postgraduate courses, programs, and in-service training programs (Romanian National Education Law no.1/2011). When applying for a teaching job in a school for students with vision impairment, it is needed to provide evidence of braille reading and writing proficiency such as a diploma supplement that proves the completion of the Braille Literacy Teaching course. Teaching braille reading and writing for students with vision impairment can be a component of a more general course on education and rehabilitation of people with vision impairment or can be a separate course that aims to develop practical skills of reading and writing braille. The general objective of the course refers to developing knowledge regarding the characteristics and implications of vision impairment or blindness in reading and writing through large print and braille. The course lasts for 42 hours (3 hours per week, meetings

face to face) and covers thematic areas such as: principles of the braille code, the methodology and stages concerning the development of literacy tactile skills development, implications of reading and writing via braille, strategies and methods used in the education of children with vision impairments, awareness with braille resources such as tactile books, and braille writing devices. In addition, the department offers more than 120 hours practice enabling undergraduate students, who have been registered to the course, to develop practical skills of learning and using contracted and uncontracted braille (i. e. groups of braille letters may be combined into a single braille cell). Finally, tactile awareness regarding braille dots and braille symbols (literary and scientific braille notation), combinations of dots to learn the letters, reading and writing syllables and words and short texts are steps followed during the braille courses in the Romanian system for undergraduate students during their higher education studies.

2.2 Greek Context and Content

The main thematic areas of the braille training in Greece regarding the training of undergraduate students who are enrolled at universities are: a. basic information about the nature of tactile perception, and b. information and characteristics of the braille code (literary and scientific notation). The course lasts one semester and all lectures are accompanied by workshops with more than 200 hours practice and in the end, all undergraduate students are assessed through a number of tests throughout the semester (on-going assessment) and through final exams at the end of the term (summative assessment). The curriculum which is developed in Greece regarding teaching and learning of braille in teacher education consists of the following strands: theories of literacy acquisition, the braille code (literary and scientific braille notation), the importance of the development pre-braille skills, the teaching of braille (read and write), hand movements in uncontracted braille, spelling, technology for braille users, assessment and selection of appropriate media for reading braille, braille reading schemes, comparisons between print and braille as well as effective practices in teaching literacy through braille.

2.3 Research Questions

Thus, the main objective of this study was to investigate undergraduate students' voices regarding their training in braille literacy. More specifically, the present study was designed to provide answers to the following research questions:

1. What were the undergraduate students' reflections on their studies regarding braille?
2. What were the undergraduate students' reflections on their training and readiness in teaching braille?
3. Were any common domains in undergraduate students' needs towards their studies in the braille code?

2.4 Significance of the Study

It is important to assess the type of learning, which undergraduate teachers acquire during their studies before they start to teach officially in special schools and/or in integrated settings. First, the process of investigating the content of the preparation in teaching braille has not been the focus of an adequate number of studies with this population. Second, it is important to detect the difficulties the undergraduate students face during their studies in braille literacy. Evidence of this situation would suggest modifications and improvements to the curriculum regarding braille instruction. Third, the comparison of the perspectives of undergraduate students who are prepared in different countries to teach braille will reveal characteristics, which may be categorized at a general level, or at domain-specific level suggesting improvements regarding the content and the process of the corresponding courses in braille literacy. This evidence will be associated with adaptive patterns reconsidering the role of braille not only to schooling but also to culture, societal norms and employment (Spungin, 1996).

3. Method

3.1 Participants

The participants in this study were 95 undergraduate students (14 males, 81 females) enrolled in higher education courses relevant to special education in two universities (Greece and Romania). In particular, 52 Greek Undergraduate Students (GUSs) ($M = 21.57$, $SD = 1.089$) were at their 7th semester of their studies and 43 Romanian Undergraduate Students (RUSs) ($M = 21.49$, $SD = 1.183$) were at their 4th semester of their studies. Their ages ranged from 20 to 26 years and all participants were about to finish their courses on braille.

3.2 Instrument and Procedure

The researchers developed a questionnaire with items and questions based on the results and/or on inferences of other relevant research (Eldridge, 1979; Johnston, 1996; Schroeder, 1989; Spungin, 1989; Stephens, 1989; Wittenstein, 1994) which emphasized that the variables which are relevant to the competence of teachers' in teaching braille are pertinent to a. the content of braille, b. teachers' confidence in teaching braille, c.

conceptualizing braille not only as a code but as a significant part of literacy, d. adequate training in braille, e. mandatory or optional courses (in universities). Hence, the authors developed a 14-item questionnaire (open and closed questions) with input from undergraduate students from both institutions. The questionnaire guide based on the above, consisted of five parts: demographic characteristics, prior knowledge about braille (1 item), reasons for learning braille (1 item), undergraduate students' reflections on their independent study regarding literary braille (7 items) and undergraduate students' reflections on their training and readiness in teaching braille (5 items) (see Appendix).

The final structure and content of the questionnaire was decided by the authors of this study and was translated and adapted into the Greek and Romanian language respectively. The translation involved the two standard procedures of (a) translation and (b) back-translation. In addition, the authors conducted pilot tests and took care to frame the questionnaires in an explanatory manner. The authors from both countries elaborated all variables they wanted to be included in the questionnaire and took into account basic factors for a survey development, such as: clarity, comprehensiveness, acceptability and convenient structure of the questions in order to identify patterns and themes in the participants' responses during the analysis (Rea & Parker, 2005; Robinson & Leonard, 2018).

Before the authors administered the questionnaires, they managed to take permission from their institutions for conducting the research, and in turn they followed the ethical principles of the Declaration of Helsinki and obtained signed consent from the undergraduate students using appropriate forms and procedures suggested by the World Medical Association. The authors clarified to all undergraduate students that the questionnaires are anonymous and there are no wrong or right answers. Finally, a cover letter was also included explaining the aim of the study.

3.3 Data Analysis

Because of the descriptive nature of the measured variables (for example, reflections on undergraduate students' independent study regarding literary braille) and the absence of latent constructs (a latent construct is a variable that cannot be measured directly), each variable was used descriptively and by itself, rather than reflecting a latent construct. Thus, the researchers – based on other relevant research - captured the variables through questions (Q) or/and items and as a result, information on the internal consistency of items or scales was not relevant because the items that were used literally represented variables. Nevertheless, it may be argued that because the items of the questionnaire were developed based on the results and/or on inferences of other relevant research (see above), the construct validity was secured by minimizing potential threats.

4. Results

The results follow the above questionnaire guide regarding the undergraduate students' responses from the two universities. The vast majority of the participants were female (73.1% Greek and 100% Romanian) and all of them had done their training in braille code.

Regarding the reasons for learning braille (Q1: *What are the reasons which led you to study braille?*), 58.3% of the GUSs stated that they chose to learn braille to differentiate their instruction and therefore facilitate blind people's access to information in school and/or in work environment (the corresponding percentage for the RUSs was 25.6%). In contrast, the majority of the RUSs (27.9%) stated that their choice to learn braille was pertinent to the alternative character that braille bears in communication and another 23.3% chose to study braille due to curiosity.

The participants' responses regarding their prior knowledge in braille code (Q2: *Did you have any background knowledge regarding braille before you decided to take this course?*) bore a resemblance. The majority of them did not have any specific knowledge of what braille was (60% for the GUSs and 65% for the RUSs respectively).

The next seven items (closed and open-ended questions) referred to the participants' reflections on their independent study regarding literary braille. When the participants were asked about the duration that was necessary for them to read and write braille (Q3) the majority of the GUSs (57.7%) needed more than 30 hours but less than 60 hours, whereas the majority of the RUSs (58.8%) felt that they needed less than 30 hours. The next question (Q4: *What was the most difficult part of learning the literary braille?*) revealed another difference between the two groups. Of the GUSs, 59.6% emphasized the memorization procedure as the hardest one for their independent study, while the responses of the RUSs consisted of a relatively equivalent proportion of statements. In specific, 48.8% considered the memorization procedure in learning braille as the hardest and 41.9% considered the procedure of typing braille characters as to be one of the hardest parts of their study regarding

braille. The fifth item was relevant to the participants' preferred method for their independent study (Q5: *What was the best way for you to study literary braille?*). Both groups seemed to converge regarding the way which was adopted to study braille. Of the GUSs, 61.5% and 62.8% of the RUSs preferred to study braille typing braille characters. The same pattern of agreements was observed within the two groups of the undergraduate students regarding the characters which were easier to learn (Q6: *Which characters of the literary braille did you find easier to learn? Can you explain in a few words why is that?*). The vast majority of all undergraduate students (60.5% of the GUSs and 86.5% of the RUSs) agreed that the letters they were taught in braille at the beginning of their training were the easiest to learn. However, the explanations between the two groups differed. Specifically, 37.2% of the RUSs stated it was easy for them to memorize because they consisted of few dot positions. On the contrary, a small percentage of the GUSs (21.2%) found some braille characters easy to learn because: a. they consisted of few dots, and b. it was easy to memorize. What is worth mentioning here is the fact the vast majority of the GUSs (78.8%) did not give any reasons why they found some braille characters easy to learn, while the corresponding percentage of the RUSs was relatively small (14%). The next item aimed at braille characters which the students found the hardest to learn (Q7: *Which characters of the literary braille did you find hard to learn? Can you explain in a few words why is that?*). Both groups pointed out that paired letters (i.e. contracted types - combinations of two vowels, such as alpha plus iota in the Greek alphabet, the so-called diphthongs) consist of the characters which are hard to learn (51.9% of the GUSs and 27.9% of the RUSs). On the other hand, the majority of the RUSs (30.2%) detected the difficulty in the letters they studied at the end of their training. Also, it is worth mentioning that 22% of the GUSs referred to the difficulties they faced when they had to study scientific notation in braille (e.g. mathematics) while there was no such reference by the RUSs. In turn, all students were asked to justify or to make comments on their challenges with braille. 30.8% of the GUSs mentioned that they were facing difficulties in learning braille characters represented by complex combinations of dot positions, whereas 34.9% of the RUSs tracked their difficulties in braille characters which are in a mirror-relationship [such as letters R (dot positions: 1235) and W (dot positions: 2456)], and 32.6% of the same group referred to the braille characters which are presented by many dot positions (such as N, Q, Y, Z). Based on the findings, it can be implied that the combination of many dot positions caused difficulties in the same proportion to the groups from the two countries. Nevertheless, the most striking point was that a significant percentage of the GUSs (55.8%) and 20.9% of the RUSs did not give any possible explanations about the challenges they were facing in braille.

In turn, the next item referred to strategies the undergraduate students were using in order to memorize better the braille code (Q8: *Did you follow a specific strategy that helped you to memorize better the braille code?*). Specifically, the GUSs' responses were categorized mainly into three groups: a. the use of a combination of the dot numbering system and the pattern which the dot positions shaped when representing a letter or a symbol in braille (34.6%), b. the use of the dot numbering system only (32.7%), and c. the use of the pattern in which the dot positions shaped when representing a letter or a symbol in braille only (28.8%). On the other hand, the RUSs' responses seemed to converge to the use of the pattern in which the dot positions formed (44.2%) and less of them (27.9%) were using a combination of the dot numbering system and the pattern which the dot positions revealed to memorize better the braille code. Finally, 27.9% of the RUSs used to use the numbering system in order to recall the braille code in their independent study.

The last item from the category of the participants' reflections on their independent study regarding literary braille was relevant to the procedure of reading and/or writing braille (Q9: *What was more difficult for you; to read braille or to write braille? and why is that?*). Based on the findings, reading braille was rated as harder for the GUSs (52.1%), whereas the majority of the RUSs (55.8%) found harder the procedure of writing braille.

The next five items (closed and open-ended questions) refer to the participants' reflections on their readiness regarding literary braille after they had completed the course. The first item of this category referred to the duration of the training in braille (Q10: *Do you believe that the duration of one semester is enough for you to learn and practice braille, both literary and scientific?*). The majority of the GUSs (53.8%) and RUSs (60.5%) felt that one semester was enough for their learning needs. However, the percentages who felt that one semester was not enough and suggested to extend their training in braille for one year were not insignificant (46.2% for the GUSs and 39.5% for the RUSs respectively). The next question aimed at the participants' readiness in teaching the braille code successfully to children with vision impairment (Q11: *How ready do you think you are in order to teach blind children braille?*). For this question, all participants rated themselves on a 5-point Likert-type scale from 1 (It is very easy for me to teach braille) to 5 (It is very hard for me to teach braille). An overall estimation revealed that the participants had the impression that they will face few or several difficulties in braille instruction when teaching children with vision impairments (71.2% of the GUSs and 74.4% of the

RUSs respectively). Also, an independent-samples t-test was conducted to compare the participants' dispositions towards braille teaching. No significant difference were found in rates for the GUSs ($M = 3.12$, $SD = 0.983$), and the RUSs [$M = 3.33$, $SD = 0.969$; $t(93) = 0.52$, $p = 0.3$]. The magnitude of the differences of the means was very small ($\eta^2 = 0.01$).

In turn, next question was germane to the participants' initiative in developing their own instructional methods in teaching braille literacy [Q12: *Assuming that you are at the beginning of teaching braille to a blind student, which are the areas that you will first focus on, in order for your student to develop good literacy skills (reading and writing)?*]. The highest percentages referred to tactile differentiation (19.2% of the GUSs and 25.6% of the RUSs). It seemed that the majority of all participants considered tactile differentiation as an important skill for blind children to develop in order to acquire efficient literacy skills. Additionally, other areas reported by the GUSs as important to focus on were a. cognitive development (17.3%), b. fine motor skills (17.3%), and c. familiarization with a braille (17.3%). The areas which were mentioned by the RUSs – apart from tactile differentiation – were a. strategies for memorization (16.3%), and b. orientation skills in finding pages (11.6%). Notwithstanding, it is worth mentioning that the percentage of missing responses to this question was relatively high. In specific, 19.2% of the GUSs and 27.9% of the RUSs did not answer the question. Relevant to Q12, was Q13 (Q13: *Do you believe that children who are blind need to develop some kind of pre-braille skills in order to learn braille?*). All participants responded positively to this question and the vast majority of them gave great emphasis on space concepts and tactile sensitivity (86.6% of the GUSs and 90% of the RUSs).

Finally, both groups characterized the braille code as a complex system (Q14: *Since you have completed your training in braille code, how would you characterize it?*) at relatively high percentages (47.1% of the GUSs and 55.8% of the RUSs). All the above results are depicted in Table 1, highlighting main themes and key-phrases from the participants making it easier for the reader to distinguish convergent and divergent aspects and perspectives from both groups (i.e. GUSs and RUSs).

Table 1. Main themes and key phrases arose from Greek and Romanian Undergraduate Students

		GUSs	RUSs
Themes	Questions	Key phrases	Key phrases
Reasons for studying braille	Q1 (reasons)	<ul style="list-style-type: none"> facilitate blind people's access to information 	<ul style="list-style-type: none"> alternative way of communication curiosity
Prior knowledge in braille	Q2 (prior knowledge/ previous experience)	<ul style="list-style-type: none"> did not have any prior knowledge of the braille code 	<ul style="list-style-type: none"> did not have any prior knowledge of the braille code
Studying literary braille	Q3 (duration)	<ul style="list-style-type: none"> 30hrs<duration<60hrs 	<ul style="list-style-type: none"> Duration<30hrs
	Q4 (most difficult of learning braille)	<ul style="list-style-type: none"> memorization 	<ul style="list-style-type: none"> memorization typing braille characters
	Q5 (effective ways to study braille)	<ul style="list-style-type: none"> practicing by typing braille characters 	<ul style="list-style-type: none"> practicing by typing braille characters
	Q6 (the easiest braille characters to learn)	<ul style="list-style-type: none"> those with the fewest dots 	<ul style="list-style-type: none"> those with the fewest dots
	Q7 (the most difficult braille characters to learn)	<ul style="list-style-type: none"> paired letters (i.e. contracted types - combinations of two vowels) scientific notation complex combinations of dot positions 	<ul style="list-style-type: none"> braille characters which have a mirror-relationship
Q8 (memorization strategies)	<ul style="list-style-type: none"> dot numbering system in combination with patterns use of dot numbering system use of the pattern which is denoted by the dot locations in the 	<ul style="list-style-type: none"> use of the pattern which is denoted by the dot locations in the braille cell use of dot numbering system 	

retrospective reflections on braille courses		braille cell	
	Q9 (reading and writing braille)	<ul style="list-style-type: none"> reading braille was rated as harder 	<ul style="list-style-type: none"> writing braille was rated as harder
	Q10 (comments about the duration of the braille course)	<ul style="list-style-type: none"> one semester was enough 	<ul style="list-style-type: none"> one semester was enough
	Q11 (readiness for teaching braille in blind students)	<ul style="list-style-type: none"> the participants felt they will face few or several difficulties in braille instruction to blind children 	<ul style="list-style-type: none"> the participants felt they will face few or several difficulties in braille instruction to blind children
	Q12 (instructional sequence in teaching braille literacy skills)	<ul style="list-style-type: none"> tactile differentiation cognitive development fine motor skills familiarization with a braille no answer 	<ul style="list-style-type: none"> tactile differentiation strategies for memorization orientation skills in finding pages no answer
	Q13 (pre-braille skills)	<ul style="list-style-type: none"> space concepts and tactile sensitivity 	<ul style="list-style-type: none"> space concepts and tactile sensitivity
Q14 (general reflection on the braille code)	<ul style="list-style-type: none"> both groups characterized the braille code as a complex system 	<ul style="list-style-type: none"> both groups characterized the braille code as a complex system 	

Note. GUSs = Greek Undergraduate Students, RUSs = Romanian Undergraduate Students

5. Discussion

The participants' reasons for choosing the braille course were clustered into three strands: differentiation, alternative access to information and curiosity. All these strands are considered fundamental for learning and developing skills.

The findings of the present comparative study (regarding the first research question: undergraduate students' reflections on their study regarding braille) were relevant to strategies applied in studying braille and identification of hard and easy parts of this study. It seemed that the vast majority of all undergraduate students preferred to study braille by typing braille characters, even though 41.9% of the RUSs considered the procedure of typing braille characters as one of the hardest parts of their study. In contrast, 52.2% of the GUSs found it hard to read braille. This finding may be justified by the students' impression that 30 hours (or less than 60 hours) are enough to learn the braille code. In fact, reading braille by sighted individuals is not a simple and de facto procedure. It requires sight orientation, recognition of dimensional structure, efficient dot scanning and symmetry detection symmetry (Heller & Ballesteros, 2006). Thus, the participants, in essence, needed more time to practice braille in order to acquire braille reading skills.

Also, the participants in this study – as all sighted persons – had a holistic approach when reading a text. According to Koenig and Holbrook (2000) that is to say, that sight can “grasp” the whole word or even the whole sentence and make sense of it, while braille – when read by sight - requires more time and energy because it is a one-to-one procedure (one cell every time). According to Chall's stages of reading development (1983), initial reading and decoding are referred to ages 6-7, while confirmation and fluency as well as reading for learning the new are pertinent to ages 7-8 and 9-14 respectively. Hence, it may be argued that even though the majority of the participants felt they mastered the braille code in a relatively short amount of time, nonetheless they started, in essence, to read from the beginning because the reading procedure via braille code was totally different of what they were used to. In addition to this, Swenson (1999) mentioned that “sighted students of all ages are fascinated by braille” (p.155) but there is need for hands-on materials and braille awareness activities to consolidate braille literacy skills.

Finally, the majority of the participants (RUSs and GUSs) stated that they memorize better the braille code when they recall the pattern, which the dot positions form. This finding is in line with relevant research which supports that individuals who are blind read braille by spatial decoding and not by using a numbering system (Heinze, 1986; Millar, 2006). It seems that there are common characteristics between the strategies the sighted

participants use when recalling the braille code with those which blind students use when they read braille. It may be argued that these spatial structures (either created by sight or by touch) constitute intellectual structures which in turn lead to coherent formations. According to Wadsworth (1989), these structures are called schemata and organize in essence events as they are perceived by the organism and classified into groups, with respect to common characteristics. The second strategy which was adopted by the 32.7% of the GUSs and the 27.9% of the RUSs was the numbering system, and it seemed that it brought them some kind of difficulties (59.6% of the GUTs and 48.8% of the RUSs stated that the memorization procedure was the hardest one for their study).

Another point which is worth to mention is the difficulties the GUSs were facing studying the Nemeth code (i. e. Nemeth braille code is an embossed dot system for encoding mathematical and scientific notation linearly using standard six-dot braille cells), whereas the RUSs did not mention it at all. This data may be justified by the limited experience the students had in this short period of their training. Also, it could be argued that literary braille and Nemeth Code have different theoretical underpinnings and for this, it might be confusing to teach them in the same course. DeMario and Lian (2000) suggest the Nemeth Code be taught in a separate course and not along with the literary braille since the Nemeth Code requires more effective instruction because of its scientific and mathematical content.

The findings regarding the second research question (what were the student teachers' reflections on their training and readiness in teaching braille?) were relevant to confidence and readiness. More specifically, it seems that the undergraduate student' confidence was not at high level because a. the vast majority felt they will face difficulties in teaching braille to blind students, b. more than 40% of the participants felt they needed more training, and c. the vast majority characterized braille code as a complex one which might be true but in conjunction with the previous two statements, it might lead to frustration when the students in questions will graduate and start teaching braille to students with vision impairment. For this, Amato (2002) points out the necessity of refresher braille literacy courses for both new and experienced teachers.

Also, the majority of the participants were aware of the importance of fostering braille literacy to their future blind students by aiming at skills such as tactile differentiation, haptic apprehension, mechanical skills (Olson & Mangold, 1981) and/or comprehension skills. On the other hand, 19.2% of the GUSs and 27.9% of the RUSs did not respond at all to this question. Perhaps these students were from those who felt that they needed more training, or they had questions about the legitimacy of their instructional strategy. Finally, all undergraduate students (approximately 90% of all participants) strongly supported that for a blind child the presuppositions to learn braille are the development of space concept and tactile sensitivity. These statements are verified from relevant literature which point out that cultivated tactile sensitivity increases the elaboration of the tactile stimuli through active exploration and as a result lead to the development of exploration strategies (Heller, 1984, 1989; Heller & Myers, 1983; Jones & Lederman, 2006; Lederman & Klatzky, 1987, 1996; Millar, 2006).

Finally, the third research question aimed to reveal common patterns in undergraduate students' needs towards their studies in terms of the braille code in both universities. It seems that the undergraduate students' statements from both institutions, although from different countries, highlighted the necessity of more practice and more familiarization with scientific versions of the braille code (such as Nemeth). This may be the case to capture all students' needs including all evidence-based practices in braille literacy (instructions, methodology, skills, use of relevant technology, etc.). Such an interesting work regarding effective practices in teaching literacy through braille has been conducted by McCall, McLinden, and Douglas (2011).

According to the obtained data, an integrated braille training material regarding the teaching of braille may be consisted of three main components: a. the core braille, which may include all the elements of the literary braille, b. the developmental braille (instructions, methodology, techniques, etc.) which may be an adjacent section to the core braille (it is expected that its content will bear many similarities amongst different countries and will depend heavily on research findings), and c. the complementary braille (reasoning and implementations regarding braille contractions).

6. Conclusions

Braille knowledge and braille instruction are identified by the Council for Exceptional Children (CEC, 2003) as one of the most important skills required for teachers of students with vision impairment (Pogrud & Wibbenmeyer, 2008). Keil's findings (2004) showed that teachers for students with vision impairment believed that braille should exist as a course in their training. Johnston (2004) for example, suggested that there is need to reconsider and reform the training needs of teachers who are responsible in teaching braille because they themselves believe to be ill-equipped for this particular task and they strongly believe that there is need for additional training in braille (it was also one of the outcomes of the present study).

In line with Johnston's perspective, Amato (2002) had suggested to increase the number of semesters where braille is being taught in universities. In 2002, 31% of the universities that included a course on braille offered braille instruction in only one semester. Amato (2002) presented that according to her respondent's braille should be taught during over two semesters. Nowadays, braille is strongly linked to assistive technological advances and professionals who work with children with vision impairment are required to master braille in conjunction with the use of AT so that they can adequately cover the diverse needs of these children (Ajuwon, Kalene, Griffin-Shirley, & Okungu, 2016; Alkahtani, 2013; Alquraini & Gut 2012; Coleman, Cramer, Park, & Bell, 2015; Papazafiri & Argyropoulos, 2018).

The main limitation of this study is the small number of participants and the fact that the students who were invited to participate in this study were only from two European countries. Therefore, the results of this research are not generalizable but there is strong evidence that we have reached internationally a threshold regarding the area of teachers' braille training because of: a. the increased braille illiteracy which has been observed in children with vision impairment, and b. the increased without appropriate assessment use of assistive technology from students with vision impairment. These comparative studies have the privilege to provide input about common needs and best practices which in turn may lead to a unified suggestion such as the Unified English Braille Code (Jolley, 2006). According to Carey (Chair RNIB, 2016), it seems that the education of students with vision impairment faces an "educational threshold" regarding the braille code and braille literacy skills and underscores its significance by the following:

"the 'war' over coding during the past two decades has absorbed a massive amount of time, energy and, yes, money, when what we need to be focused on is the survival of braille as a viable literary option".

Many debates are arising internationally in the last decade about the braille code and the use of assistive technologies. Some of these debates challenge the effectiveness of the braille code compared to the immense capacities that AT has brought to the fore, whereas other debates focus on the complementarity of AT in the use and enhancement of braille literacy skills. In addition, it has to be mentioned that the braille code has many formats such as literary braille, music braille notation or/and scientific braille notation such as the Nemeth code. Nemeth code (Nemeth, 1972) is a well-known braille system for mathematics and science used in North America as well as in other countries and it seems that teachers need to practice more in braille scientific notations because they contain many combinations of dot patterns compared to the literary braille notation (Asebriy, Raghay, & Bencharef, 2018; Penava, Prcić, & Iličić, 2017). Perhaps the answer is in the middle; the role of AT, including augmentative technology, communication technologies, or/and alternative technologies is crucial in order to build up literacy experiences and skills in students with vision impairments and/or with sensory disabilities. An auxiliary technology guide would help undergraduate students as well as professionals to ensure that all features related to technological development are addressed and consequently be able to design and introduce a process appropriate for all students, such as software and devices use, design and implementation of tailor-made equipment adaptations, design and implementation of technology plans and formulation of the appropriate environment to enhance the use of technology (Wong & Law, 2016). For this, higher education studies relevant to special education, such as braille literacy, has to be coupled with AT opening up broadened concepts of literacy and communication entailing new ways of teaching and instruction (Argyropoulos et al., 2019; Bruce & Borders, 2015; Edyburn, 2000; Hersh, 2013; McLinden, McCall, Hilton, & Weston, 2006; Ruppap, Gaffney, & Dymond, 2015).

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Appendix

Semester:..... Age.....

Gender: MALE

FEMALE

Q1. What are the reasons which led you to study braille?

Q2. Did you have any background knowledge regarding braille before you decided to take this course?

- YES NO

If your answer is YES, please write down what did you know about braille, and how did you get this knowledge

Q3. How many hours did it take you to learn braille? (choose one of the following)

- Less than 30 hours
 More than 30 hours and less than 60 hours
 More than 60 hours

Q4. What was the most difficult part of learning the literary braille? (choose one of the following)

- Memorization
 Typing braille characters
 Something else? (please specify below)

Q5. What was the best way for you to study literary braille? (choose one of the following)

- Memorization
 Typing braille characters
 Something else? (please specify below)

Q6. Which characters of the literary braille did you find easier to learn? Can you explain in a few words why is that?

Q7. Which characters of the literary braille did you find hard to learn? Can you explain in a few words why is that?

Q8. Did you follow a specific strategy that helped you to memorize better the braille code? For example, did you use a strategy which was

- based on the dot numbering system?
 based on the pattern which the dot numbering system represents for every symbol (literary or mathematical)?
 based on the two approaches above?
 based on another approach? If this is the case, can you provide us some information about this approach?

Q9. What was more difficult for you; to read braille or to write braille? and why is that?

Q10. Do you believe that the duration of one semester is enough for you to learn and practice braille (both literary and scientific)?

- YES NO

If your answer is NO, how much time do you think is needed to integrate your studies in braille (please write below)

Q11. How ready do you think you are in order to teach blind children braille? (Please choose one of the following)

- It is very easy for me to teach braille
 It is easy for me to teach braille
 It is neither easy nor hard to teach braille
 It is hard for me to teach braille
 It is very hard for me to teach braille

Q12. Assuming that you are in the beginning of teaching braille to a blind student, which are the areas that you will first focus on, in order for the student to develop good literacy skills (reading and writing)? (please provide your answer in a few words)

Q13. Do you believe that children who are blind need to develop some kind of pre-braille skills in order to learn braille?

- YES NO

If your answer is YES, please refer to some pre-requisites.

Q14. Since you have completed your training in braille code, how would you characterize it?

- simple
 complex
 sufficient
 insufficient
 Other characterization? (give a reason for your answer)

THANK YOU SO MUCH FOR YOUR COOPERATION

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