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The Braille system – a stimulator or an inhibitor in the upbringing and inclusive education of students with visual impairments?

System Braille'a – stymulator czy inhibitor w wychowaniu i edukacji inkluzyjnej uczniów z niepełnosprawnością wzroku?

Abstract

Introduction. Recognizing the obligatory use of Braille techniques in the upbringing and inclusive education of students with visual impairments is an indisputable issue, the following issues were addressed: the Braille system as an alternative form of contact with the written word, teaching the Braille system to children and adolescents, the educational and communicative significance and the use of Braille, its future, and its conditions for further development.

Aim. The goal is to draw the attention of tutors (including parents) and educators to the indispensable role of the Braille system and techniques for the psychosocial functioning of blind children, for their real education and social inclusion.

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Materials and methods. Descriptive and critical analysis of the subject literature.
Results and conclusion. Currently, the Braille system is not given due recognition from students with profound visual impairments, their parents, and teachers. Educators and parents are not aware that the Braille system determines the acquisition of literacy, *i.e*., access to the written word; mastering the rules of spelling, punctuation, grammar of the native and foreign languages; enables familiarizing oneself with the arrangement of text on a page; provides access to sources: textual, mathematical, physical, chemical, computer, musical, graphic; prevents secondary illiteracy; creates equal educational and professional opportunities; allows participation in social, scientific, technical, and cultural life. Introducing Braille reading at the early development stage of a child with visual impairment is recommended. It is necessary to integrate tactile and auditory materials and techniques in the course of education and training.

***Keywords*:** visual impairment, the Braille system, raising a child with visual impairment, inclusive education of children with visual impairment.

Abstrakt
Wprowadzenie. Obligatoryjne wykorzystanie w wychowaniu i edukacji inkluzyjnej uczniów niepełnosprawnych wzrokowo technik brajlowskich jest kwestią bezdyskusyjną. W tym kontekście w artykule odniesiono się do następujących zagadnień: systemu Braille'a jako alternatywnej formy kontaktu ze słowem pisanym, nauczania systemu Braille'a dzieci i młodzieży, edukacyjno-komunikacyjnego znaczenia i wykorzystania pisma Braille'a, jego przyszłości i uwarunkowań dalszego rozwoju.
Cel. Celem nadrzędnym podjętego dyskursu jest zwrócenie uwagi wychowawców (w tym rodziców) i edukatorów (zwłaszcza w systemie inkluzyjnym) na niezastąpioną rolę systemu Braille'a i technik brajlowskich dla psychospołecznego funkcjonowania niewidomych dzieci, dla ich rzeczywistej, a nie pozorowanej edukacji i inkluzji społecznej.
Materiały i metody. Analiza opisowo-krytyczna literatury.
Wyniki i wnioski. Obecnie system Braille'a nie cieszy się należytym uznaniem wśród uczniów z głęboką niepełnosprawnością wzroku, ich rodziców i nauczycieli (zwłaszcza w szkołach ogólnodostępnych). Edukatorzy i rodzice nie mają świadomości, że system Braille'a pozwala na nabycie umiejętności czytania i pisania, czyli na dostęp do słowa pisanego. Dzięki niemu możliwe jest opanowanie zasad ortografii, interpunkcji, gramatyki języka ojczystego i języków obcych, umożliwia on także zapoznanie się z rozmieszczeniem tekstu na stronie, udostępnia źródła tekstowe, matematyczne, fizyczne, chemiczne, informatyczne, muzyczne i graficzne, zapobiega wtórnemu analfabetyzmowi, stwarza równe szanse edukacyjne i zawodowe, pozwala uczestniczyć w życiu społecznym, naukowym, technicznym, kulturalnym. Wskazane jest wprowadzanie brajlowskiej inicjacji czytelniczej na etapie wczesnego wspomagania rozwoju dziecka z niepełnosprawno-

ścią wzroku, potrzebna jest także edukacja nauczycieli i rodziców w zakresie czytania i pisania systemem Braille'a. W toku wychowania i edukacji niezbędne jest integrowanie materiałów i technik dotykowo-słuchowych. Rzeczywista, a nie pozorowana edukacja inkluzyjna uczniów z głęboką niepełnosprawnością wzroku to uznanie systemu Braille'a za jej stymulator, a nie inhibitor.

Słowa kluczowe: niepełnosprawność wzroku, system Braille'a, wychowanie dziecka z niepełnosprawnością wzroku, edukacja inkluzyjna dzieci z niepełnosprawnością wzroku, nauczanie systemu Braille'a.

Introduction

The ability to read and write is regarded as a resource of society. Literacy is therefore a basic, compulsory tool for students (including those with special educational needs) in segregated, inclusive and mainstream education. It is a prerequisite for them to follow the successive stages of schooling and to prepare for adult life.

The ability to read and write is a resource for mastering the basic competencies necessary for social functioning. It enables the self-expansion of knowledge and skills, i.e., self-improvement. Writing is one of the basic, next-to-speech, forms of interpersonal communication, making it possible to communicate regardless of time and space (*cf*. Brzezińska, 1992).

One of the basic prerequisites for the intensively promoted inclusion of people with disabilities (both social and educational) is efficient communication through the written word. In the case of profoundly visually impaired people (especially the blind), this should be the ability to use the Braille system (the names used are: writing, Braille system or alphabet, and in the polonised version: Braille system, Braille alphabet, Braille, or raised dot writing).

The Braille system as a topic of interdisciplinary research has produced formally diverse literature on the subject (scientific articles in professional periodicals and collective works, encyclopaedic entries, methodological studies), published mostly in the field of pedagogical sciences (tyflopedagogy, tyflodidactics), psychological sciences (tyflopsychology), on media and social communication (bibliology and informatology) and technical sciences (tyfloinformatics). Studies include the history of Braille writing and books (e.g., Czerwińska, 1999; Czerwińska, Paplińska, 2016), teaching the Braille system and drawing to children and adults (e.g., Marek, 2007; Paplińska, 2009, 2012c; Chojecka, Magner, Szwedowska, & Więckowska, 2008), tactile teaching aids, e.g., tiflography (Jakubowski, 2009; Więckowska, 2011; Olczyk, 2016; Czerwińska, 2017), the use of the Braille system in information and communication technologies and modern educational aids (Jakubowski, 2001; Paplińska, 2005a; Wiazowski, 2015, 2016).

Meanwhile, long-term observation of the functioning of visually impaired students confirmed in the literature (e.g., Paplińska, 2015), indicates that the level of ICT literacy outweighs the skills of self-care, independent movement with a white cane and – particularly important from an educational-communication perspective – knowledge and proficiency with the Braille system, and thus efficient reading and orthographically correct writing in the mother tongue and a foreign language, or reading a tylograph. This peculiar information paradox raises concerns about whether blind children and young people are at risk of illiteracy (Faherty, 2006). These concerns are all the greater because blind students, as citizens of the information society faced with the need to constantly acquire and process information, choose ICT tools based on speech synthesis. They claim that these completely satisfy their information and communication needs, rendering the Braille system useless. They are often reinforced in their position by teachers (especially in inclusion and inclusive education) who exempt them from reading and writing (in Braille or traditionally) and replace these skills with memory learning, reading and writing by a reader, oral statements, auditory retrieval of information (using talking devices, audiobooks). Also among parents of visually impaired children, the Braille system is not given due recognition and is not the subject of educational and therapeutic interventions (e.g., in early development support).

The use of Braille techniques in the upbringing and inclusive education of visually disabled students is obligatory. This paper addresses the following issues: the Braille system as an alternative form of contact with the written word, the teaching of the Braille system to children and adolescents, the upbringing, educational and communicative significance and use of Braille, its future and conditions for further development.

The primary aim of the discourse undertaken is to draw the attention of educators (including parents) and educators (especially in the inclusion system) to the indispensable role of the Braille system and Braille techniques for the psychosocial functioning of blind children, for their real and not sham education and social inclusion. The Braille system and Braille techniques are stimulators, not inhibitors, of the upbringing and education (also of inclusion and integration) of visually impaired students – which the author tries to convince based on her own long-term experience, interdisciplinary research exploration, and descriptive-critical analysis of the literature.

Visual and tactile reading – educational and social skills

Two definitional approaches to reading are known in the pedagogical literature: linguistic and psychological (Kamińska, 2005). In the currently criticised linguistic approach, the technical side of reading is crucial. The phonetic definition of reading, which is prominent here, assumes that it is “a way of translating specific graphic

signs into the sound side" (Klus-Stańska, Nowicka, 2009, p. 15). The nowadays recognised psychological approach (psycholinguistic or pedagogical-psychological) emphasises "the complexity, multifacetedness and much wider range of linguistic and cognitive operations that make up reading-related competencies" (Klus-Stańska, Nowicka, 2009, p. 17).

The common understanding is that reading is a skill attributed to sighted people, as reflected in the definitions themselves (*cf*. e.g., Tinker, 1980; Mystkowska, 1977; Styczek, 1979). Faced with this, the notion of Eve Malmquist deserves attention: "Reading should be understood as a series of common mental activities that are largely different, because they vary, depending on the age and maturity of the reader, on the type of text to be read, on its degree of difficulty and the purpose of reading" (Malmquist, 1982, p. 117).

The statement by Anna Brzezińska, who considers reading to be the interaction of three interdependent aspects: technical, semantic and critical-creative, is also characterised by universalism. The technical aspect refers to the ability to recognise, associate and differentiate letters, letter combinations, and sounds and to reproduce them verbally promptly. The semantic aspect refers to the association of recognised signs and understanding the meaning of words and sentences. The critical-creative aspect involves responding to the text read, evaluating the content read and interpreting the text literally and figuratively (Brzezińska, 1987). The author distinguishes three aspects of reading: technical (recognition, association, and differentiation of graphemes and phonemes, their verbal reproduction in due time), semantic (understanding of the read text – decoding graphic and phonic signs) and critical-creative (reflexive, critical attitude to the read text) (Brzezińska, Burtowy, 1985).

Research on the psychophysiological mechanisms of reading underlying the construction of various definitions of reading has been conducted since the mid-19th century. They refer to sight-reading, but in many of their findings, they address the specificity of tactile reading (*cf.* e.g., Cackowska, 1984).

The psychophysiological mechanisms of reading require the involvement of different analysers and different floors of the nervous system. In the initial stage of reading, visual (tactile), auditory, and articulatory functions play a leading role. In the final stage, when the activity is automatic, comprehension (mental interpretation of the text) plays the leading role. The structure of the sight-reading activity, which is considered the norm, consists of visual, auditory, articulatory and semantic functions. These have been comprehensively described in a rich literature (e.g., Tinker, 1980; Cackowska, 1984).

The teaching of reading has a rich methodology, from which the teaching methodology of the Braille system draws. Synthetic methods, which are among the oldest,

focus on the technical aspect, i.e., reading fluency. They are based on moving from an element (letter, vowel, syllable) to a whole (word or sentence). A distinction is made between alphabetic, phonetic (voicing) and syllabic methods (*cf*. Kamińska, 2005; Gruba, 2002; Wieszczeczyńska, 2007). Analytical methods take as their starting point a word, a sentence fragment or a whole sentence (word variety and sentence variety of the method). The development of these methods led to the emergence of analytic-synthetic methods and the global method for learning to read (*cf*. Kamińska, 2005).

Analytic-synthetic methods, considered in Poland to be the most effective in initial reading instruction, emphasise both the technical and the meaningful side of reading. The starting point is a word or sentence. With the help of auditory or visual analysis, one moves from a sentence to a word or from a word to a syllable and on to a vowel. This is followed by the reverse process, i.e., synthesis, the construction of new wholes from already known components: syllables, words, and sentences. Analytical-synthetic methods have three varieties: visual, phonetic and functional (*cf.* Gruba, 2002; Wieszczeczyńska, 2007; Czelakowska, 2009).

Global methods consider words and sentences that are learnt as a whole as a starting point. They do not use the division into elements of learned wholes and the assembly of these wholes. Words and sentences are recognised based on guesswork. The group of global methods currently includes Glenn Doman's method (Doman, Doman, 1992) and Irena Majchrzak's method (2004).

Concepts of learning to read emerging today are mostly modifications of analytic-synthetic or global methods. These include, for example, Bronisław Rocławski's phonetic-letter-colour method (1990), Marta Bogdanowicz's *Method of Good Start* (Bogdanowicz, Barańska & Jakacka, 1998) and Jagoda Cieszyńska's simultaneous-sequential method of learning to read (2006).

A. Brzezińska, following Jan Zborowski, classifies methods of learning to read according to criteria:

logical – taking into account the elements of written speech and their phonetic values (methods: alphabetic, phonetic, syllabic, word, and sentence methods);

- psychological – taking into account the mental process occurring during reading (methods: synthetic, analytical, analytical-synthetic);
- physiological – with the domination of one of the senses (methods: auditory, visual, kinesthetic) (Brzezińska, 1987).
- This classification can also be applied to tactile reading when supplemented by the sense of touch.

The characteristics of good reading as defined in reading teaching methodology can also be related to the specifics of reading with the Braille system. These are fluent reading, correct reading, fluent reading, and expressive reading (also called "expressive"

reading) (*cf*. Kulpa, Więckowski, 1983; Jakubowicz, Lenartowska, & Plenkiewicz, 1999; Czelakowska, 2009). The forms (types) of reading used in sight reading are applicable in tactile reading: reading aloud (teacher and student – individual, group and role-play reading), silent reading, and whisper reading (Klus-Stańska, Nowicka, 2009; Jakubowicz et al., 1999).

Proficient tactile reading enables reading comprehension, which is attributed to visual reading. Thus, four degrees of comprehension are possible:

- understanding of words and phraseological compounds (meaning of words derived from context, synonyms, antonyms, ambiguities, and phraseological compounds);
- understanding the information contained in the text (simple cause and effect relationships);
- understanding the main idea (the essential sense of the read text, generalisation, which contains the main idea of the text);
- understanding the value of the text being read (mood, nature of the content conveyed, distinguishing, for example, realism or fantasy, grasping information not directly given in the text, evaluating facts, events and attitudes) (Plenkiewicz, 1994).

Tactile reading does not limit critical-creative reading, which is extremely important for modern people. It is a creative process of "processing, explaining, interpreting, and evaluating the information contained in the text by the recipient" (Plenkiewicz, 1994, pp. 127–128), and thus takes place on the levels of informing (handling information), explaining (processing information), and evaluating (evaluating information).

Braille system – morphology of writing, the mental basis of tactile reading

The Braille system is characterised by its inherent morphology. The number of dots and their reciprocal arrangement in a sign give 63 combinations: 6 one-point characters, 15 two-point characters, 20 three-point characters, 15 four-point characters, 6 five-point characters, 1 six-point character, and 1 zero-point character – space. The international ordering of Braille characters by assigning them a numbering and arranging them in an array (the so-called "Monnier array") was carried out by Jean-Jacques Monnier in 1907. The table organises the signs into seven series. Series I is the basis for a further five series. Series VII contains three subsidiary marks. Series II contains the marks of series I with the addition of mark 61 of series VII. Series

III contains the characters of series I with the addition of character 62, and series IV with the addition of character 63 from series VII. Series V is formed from the reduction of series I characters. Series VI is a fragmentary repetition of the previous series, with two characters per series: the first two and last two characters of this series correspond to series I and series V. The six central characters, formed from the first two signs of this series by successive addition of the three subsidiary signs, correspond to series II, III, and IV. The place of each character of the derived series (II, III, IV, and V) corresponds closely to the position of a character in series I. The characters of series I and II and partly III correspond to the Latin alphabet. The characters of series I, preceded by a numeral, form the numerals. The characters of the V series are used for punctuation. All other characters can be used according to the requirements of particular national languages (Czerwińska, 1999, 2003).

Monnier's table is used for musical, mathematical, physical, chemical and computer notation, as well as for orthographic abbreviations and Braille shorthand. By unambiguously defining the place of each character in the system, it highlights its remarkable logicality (Czerwińska, 2003, 2019).

The Braille code allows for two types of notation: integral and abbreviated (Dycht, 2016; Paplińska, 2016a). Integral notation (Braille Grade 1, Uncontracted Braille) is a faithful letter-by-letter and character-by-character transcription of black-print text. Abbreviated notation involves substituting coincidences of letters or words under individual Braille signs. Abbreviated notation is not phonetic, it accurately reflects the orthographic form of the full text (Józefowicz, Saloni, 1991). Braille abbreviations have been developed for individual languages and depend on the characteristics of the language in question and the concept of the particular abbreviation system. Therefore, the number of braille characters and total abbreviations varies between languages. In English-speaking countries, the most common type of braille notation is Braille abbreviation – Braille Grade 2 (Braille Grade 2, Contracted Braille) (Dycht, 2016; Paplińska, 2016a).

Due to the introduction of Braille into information and communication technology, modifications have been made to the morphology of the Braille sign, resulting in the modern variant of the system, Eurobraille. It is based on an octopoint (two columns of four dots) while retaining the numbering of the basic dots as in the standard version. This gives 256 characters, including special characters for writing IT symbols, and allows for Braille support of microprocessor devices (Czerwińska, 2019). The height of the standard braille mark is approximately 10 mm, the width is approximately 6 mm and the thickness of the dot is approximately 0.5 mm.

The findings of experimental psychology confirmed Ludwig Braille's intuition at the turn of the 20th century relating to the specific functioning of the sense

of touch, sense compensation, and the structure of visual and tactile reading, e.g., research by Teodor and Szymon Heller, Karol Burklen, and Maria Grzegorzewska (in: Grzegorzewska, 1926, 1927; Klimasiński, 1984; Czerwińska, 1999).

Concerning considerations relating to tactile reading, it should be noted that touch does not have the ease of vision in perceiving a continuous line but is a sense of intermittent sensations. Tactile perception of surfaces is more difficult than that of convex points. The range of attention is limited: the number of straight elements perceived in one act of perception cannot exceed six. Ordered impressions are perceived more easily than disordered ones. A Braille sign does not exceed the tactile field of the fingertip. The remoteness of the Braille signs slightly exceeds the tactile acuity threshold (the so-called "Weser spatial threshold"), which facilitates the recognition of individual signs. Touch allows recognition of size and shape (inaccurately).

T. Heller proved that there is a distinction between synthetic (passive) touch, which serves to create general images, and diagrams of objects, and analytical (active) touch, which allows the details of objects to be explored. The researcher described tactile cognition as sequential (temporal-spatial succession of information acquisition) and visual cognition as simultaneous (in: Majewski, 2002; Czerwińska, 2004).

The course of text perception and reception in tactile reading is conditioned by the properties of the orientation-cognitive sphere. Cognition of reality by blind people is based on the phenomenon of compensation. Within cognitive compensation, sensory compensation is of particular importance, explained by M. Grzegorzewska with the theory of the formation of dynamic structural systems within the 1st and 2nd signalling systems (the 1st signalling system includes the senses, the 2nd system – thinking and speech) (Grzegorzewska, 1926). For the process of text reception, it is significant that sensory compensation is supported by verbal compensation, which involves the cognitive use of speech functions (II signalling system) (in: Czerwińska, 2004, 2019).

Properly formed surrogate imagery, which is an important element of a blind person's cognitive processes, filling in perceptual gaps, conceived as an expression of the desire to construct a reasonably adequate image of reality and to use the language of sighted people, is of great importance for the reception processes during reading. For these representations concern spatial relations, objects and their features, as well as light and colour. Analogical thinking, inference, and speech play an important role in their formation (Czerwińska, 2004, 2019).

For tactile reading, the intellectual capacity of the blind person is also important. It should be noted here that visually impaired people are able (with correct developmental stimulation) to reach the highest stage in the development of their thought processes, i.e., abstract and conceptual thinking. Rapid progress in abstracting,

differentiating, classifying, diagramming, and searching for analogies is noted. Reasoning by analogies fosters an enrichment of knowledge about the appearance of the "world of sighted people." It has a huge role in determining the external characteristics of objects, e.g., colour and shape, when explaining emotional characteristics, and describing sensory experiences. It makes it possible to define relations between concepts, gives a broader picture of the phenomenon being explored, and compensates for the effects of not being able to visually explore images, objects, and phenomena. It should therefore be pointed out that the specificity of a blind child's thinking is logical and fast (the result of a tendency to form). A constant concentration of attention is also characteristic; it is constantly active, flexible, mobile and divisible (Czerwińska, 2004, 2019).

Sensory compensation is supported by verbal compensation, which involves the cognitive use of the speech function, i.e., supporting sensory cognition with verbal instruction. For the blind person, speech is a factor that informs, instructs, explains, and shapes feelings and judgements, a form of communication and expression. Stimulating the development of a blind child mainly through verbal compensation leads to verbalism, i.e., the use of vocabulary without understanding its perceptual content. Verbalism more often affects younger children with less perceptual experience. It is also conditioned by the intellectual level of the blind person.

Effective Braille reading is influenced by motor skills (especially manual dexterity) and lateralisation (right-handedness is recommended). This is because the recommended reading technique is ambidextrous (with differentiated functions of the hands: right hand – leading, synthesising, left hand – supporting, analysing) and using all fingers, with the leading fingers pointing. Using the aforementioned technique, the average reading speed is 66 words per minute for children and 100–120 words per minute for adults. Similar conditions of psychomotor development apply to the activity of writing, which is carried out both with a slate and a chisel (the basic writing tools in the Braille system), a Braille machine or an electronic Braille notepad.

Research indicates that the legibility of Braille text is the result of the influence of the tactile characteristics of neighbouring signs (characteristics – the number of and configuration of dots in a sign). The level of perception and reception of a Braille text depends on the perceptual determinants: object-related (text) and subject-related, i.e., the conditions of the blind person (age, time of onset and cause of visual dysfunction, specificity of cognitive and executive processes, specificity of the emotional-motivational sphere and social functioning) (Klimasiński, 1984; Czerwińska, 1999). The difference between the structure of sight-reading and tactile reading occurs only at the level of sign perceptions, while the mental activities (reception) are not different (Grzegorzewska, 1927).

Learning to read and write tactilely – a challenge for the blind child, parents, teachers

The effectiveness of the use of the Braille system in the educational process is contingent on early Braille initiation and its proper (methodical) teaching. These interactions should fall within the scope of early developmental support for the visually impaired child and lead to proficiency in writing as a tool for contact with human thought, i.e., the ability to read and write with understanding. It is therefore advisable that the process of preparing a visually impaired child for learning to read and write begins very early and proceeds in four directions: manual improvement, activation of thinking, formation of mathematical concepts, and training of auditory functions (Kawczyńska-Reguła, Pierzchała, 2001).

The essential learning of the system should be preceded by the arrangement of a situation to familiarise the child with writing points, a task which falls primarily to parents and early childhood development specialists. In the USA, this is referred to as "Braille immersion"; in the UK, France, and Sweden, it is referred to as labelling the environment, with the introduction of words that are meaningful to the child as a priority. The core of children's braille immersion is to provide haptic experiences with tactile writing in the child's immediate space (home, nursery, and school) by introducing braille labels. Children develop tactile recognition skills and an awareness that the Braille text has some meaning (Paplińska, 2005a, 2007, 2012b).

The process of learning to read and write in Braille comprises two stages: preparatory (so-called "pre-Braille") and actual learning (Czerwińska, 2015, 2016, 2019). During the preparatory period, indirect and direct preparation is implemented. Indirect preparation focuses on the stimulation of psychomotor development, especially of the orientation-cognitive sphere. It includes exercises to develop spatial concepts, body schema, and spatial orientation, exercises to improve sensory compensation using the senses of touch and hearing, exercises to develop auditory sensitivity, phonemic hearing and speech, exercises to develop fine motor skills and tactile perception. Direct preparation is mainly related to the development of manual dexterity and tactile perception towards learning Braille. Exercises that directly prepare children for tactile reading and writing include, e.g., moulding and modelling, drawing with crayons and paints, using scissors, getting used to the slate, chisel, and Braille machine, getting used to sitting quietly while listening to reading, listening to a story or listening to a recording, learning to read and identify simple Braille drawings, e.g., with only geometrical shapes, learning basic skills related to Braille reading (positioning and guiding the hands and fingers along convex rhymes, coordinating and cooperating with both hands in finding the beginning and end of a poem, searching for the beginning and end of a poem, finding the beginning and the end of a poem, and learning basic skills related to Braille. practising reading and identifying simple Braille drawings, e.g., with geometric

shapes only, learning the basic skills involved in reading Braille (positioning and guiding the hands and fingers along raised lines, co-ordination and co-operation of both hands in finding the beginning and end of a line, finding and moving to the next line, turning pages in a book, etc.), exercising hand muscles through chiselling on a Braille board and playing in relief writing using the Braille machine, developing motor coordination (e.g., drawing geometric shapes on foil using a chisel, shapes close to the child, e.g., own hand, foot, etc.), introducing exercises own hand, foot), exercises introducing the concept of the hexapoint, developing orientation in an enlarged model of the hexapoint, the ability to distinguish and identify several, several Braille letters, teaching the ability to operate the Braille machine, awakening interest in language and writing generally (Paplińska, 2007, 2008, 2012b, 2012c, 2012d). Barbara Kawczyńska-Reguła also mentions: exercises introducing the concept of the hexapoint on the model, exercises introducing the order of points in the hexapoint by mapping their layout and making combinations with reading out the points, exercises in tactile sensitivity and correct pressing with the fingertips of the appropriate fingers, exercises to keep in line, e.g. walking on the line with the hexapoints without spaces and with spaces. Practising staying on the line, e.g., walking on the line with the six dots without spaces and with spaces, getting to know the Braille board, attaching a piece of paper to the board, practising punching points in the board with a chisel (the teacher shows the direction of writing from right to left and how to punch the points), removing a piece of paper with a text, reading (the teacher shows the direction of reading from left to right), attaching a piece of paper with a written text again (Kawczyńska-Reguła, Pierzchała, 2001).

In teaching the Braille system, there is a traditional approach, focused on developing basic perceptual and motor skills, related to reading and writing, based on a controlled, progressively expanded vocabulary (Paplińska, 2006). This approach emphasises sequential teaching of isolated skills, e.g., guiding hands and fingers along a Braille verse, finding the next line, etc. Alternative approaches are programmes based on holistic learning – so-called "holistic," oriented towards reading comprehension, the integration of listening, speaking, reading, and writing skills into a single whole and the use of exercises based on children's own language experiences (Kuczyńska-Kwapisz, Paplińska, 2006; Paplińska, 2005b, 2006, 2007).

Particularly noteworthy is the holistic (global) method popularised in Poland by M. Grzegorzewska (1927). The young child tends to perceive phenomena holistically, so the letter and syllable are for him or her something abstract, and difficult to understand. The syncretism of perception justifies the adoption of the following direction in learning to read: whole sentences, words, syllables, and letters. According to psychological assumptions, the starting point is the child's experiences, concrete observations and perceptions. On this basis, sentences are formed, which are then divided into words, which are analysed and divided into syllables and letters (Bendych, Nowak, 1985).

- In the process of teaching the system, didactic resources are used for a variety of uses:
- sensory aids – mats, transparencies, magnetic boards, blocks, plasticine, modelling clay, signs, and figures with tabs to develop the ability to distinguish basic geometric figures, show directions on a plane using both hands;
- tactile dominoes, manipulative boards, string and thread, finger paints, plastic, clay – these are used to develop the ability to recognise similarities and differences between objects according to their tactile characteristics, to separate and classify objects according to their characteristics and purpose. They are used to teach the ability to quickly move their hands around a sheet of paper, objects and symbols and to develop the ability to turn them around, point to the top, bottom, right and left of a sheet of paper;
- blocks, folding boxes with holes, plush toys, pacemakers, and toys that require the use of different amounts of pressure – are used to strengthen the shoulder girdle, shape fluidity of movement, and teach correct grasping (Czerwińska, 2015, 2016; Czerwińska, Kucharczyk, 2019);
- tactile books (themed books) – develop orientation in small spaces, tactile perception, motor coordination, imagination, and vocabulary, and introduce the concept of the six-point (Kazanowska, 2012; Czerwińska, 2015).

A helpful tool to prepare for basic learning of the Braille system is the Mangold programme, aimed at blind children from the age of 5. It can also be used for older children who find it difficult to learn the system. The aim is to familiarise children with Braille and to initially train their reading technique, to develop tactile perception, to form the so-called "light touch" (the ability to use minimal pressure in the contact of fingers with convex writing, to reduce and eliminate unfavourable vertical and horizontal hand movements), to implement the use of both hands when reading, to develop the ability to orientate on the plane of the sheet, to locate lines of text, columns, drawings, and the ability to focus attention. The skills to be mastered by the student are divided into 29 subgroups. The level of exercises is adapted to the different pace of work. Learning with this programme, with daily classes, should take between 6 and 16 weeks. The programme is equipped with a commentary for teachers and Braille exercise cards for students. Edition II has been supplemented with Polish letters.

The Mangold programme is not a complete reading curriculum. It should only be used at the stage of developing tactile perception and letter/symbol Braille recognition processes. After completing the programme, the child should make few regressive hand movements, use an ambidextrous reading technique (the left hand looks for the beginning of a new line and the right hand finishes reading the previous line), use four fingers with little pressure, understand the text and analyse it (Czerwińska, Kucharczyk,

2019). Sally Mangold emphasises that it is important to keep in mind the other elements of a holistic reading curriculum – the development of concept use, auditory differentiation, and phonetic skills (Mangold, 2000). Therefore, the programme should be integrated harmoniously into the process of learning to read, and actually into the child's holistic development programme (Hadamik, Więckowska, 2012).

For children who already identify Braille letters or who are in the process of learning the system and for pupils with reading and writing difficulties, the educational package *Mały Hipo I. Brajl dla niewidomych dzieci* [Little Hipo no. I. Braille for blind children]. It includes an educational computer game consisting of methodically planned sequences of exercises based on the integration of reading, listening, and writing skills. The package includes sets of worksheets and tactile drawings improving the ability to read both Braille text and relief graphics, as well as blocks stimulating the development of tactile perception (Paplińska, 2012a).

The Braille teaching framework developed by Małgorzata Paplińska consists of three parts. The first contains preparatory exercises for learning to read and write, which should be conducted in kindergarten. These include the development of perception, awareness, and orientation in small and large spaces. The author also encourages the use of Western models and labelling of the environment. Part two is for proper learning of the integral writing system at the early childhood education level. Part three is for learning Polish Braille orthographic abbreviations. It is addressed to proficient users of the system. The author also introduces the technique of one-handed braille typing (in: Czerwińska, 2015, 2016).

Most teachers develop proprietary curricula for teaching point handwriting, which are sometimes modelled on concepts and primers used to teach black-print letters. These are not fully acceptable solutions. However, the range of textbooks and primers for teaching the Braille system is modest. *Elementarz dla dzieci niewidomych* [The elementary book for blind children] developed by Rozalia Mekler and Wanda Wantuch proposes learning to read using the global-analytic-synthetic method (Mekler, Wantuch, 1979; Czerwińska, 1999).

Mój elementarz [My elementary schoolbook] prepared by Józefa Kamińska, B. Kawczyńska-Reguła, and Bożena Pierzchała proposes teaching reading and writing using the analytic-synthetic method. This textbook also exists in a printed version for the visually impaired child. It uses a variety of texts: readings, poems, fairy tales, dialogue texts, riddles, and picture stories. The text themes relate to the child's immediate environment. Printed relief, multi-layered drawing with different surface textures is applied. *Mój elementarz* contains 39 labelled pictures introducing letters and binary signs in the following order: a, l, b, k, c, m, o, u, d, e, s, t, g, i, j, y, p, r, n, w, h, ł, ę, ą, ó, ś, ż, rz, ch, ć, ź, ń, sz, cz, dz, dż, dź (Kamińska, Pierzchała, & Kawczyńska-Reguła, 1996). A manual for learning the system, developed by M. Paplińska *Nauka brajla w weekend* [Learning Braille at the weekend], should also be mentioned here. It is addressed to sighted people (e.g., parents, educators,

or therapists of blind children). It is based on the so-called "black-print braille" – a type of flat writing that faithfully reproduces the Braille system (Paplińska, 2004, 2009).

Learning the Braille system is based on the simultaneous training of reading and writing skills. In learning to read, the aim is for the student to acquire the so-called "model technique," i.e., ambidextrous, with a division between the functions of the left and right hand and using at least two fingers of each hand (index and middle). According to Tokisuke Kusajima's model, ambidextrous reading can be realised in several ways: left marks pattern, split pattern, scissors pattern, and parallel pattern (in: Paplinska, 2015).

It should be emphasised that no correlation is observed between the dominance of either hand and the use of that particular hand for tactile reading. There is, in fact, a correlation between the choice of technique and reading speed, with an advantage for ambidextrous reading. Reading speed is also influenced by finger movements; slower circular movements are the result of difficulties in recognising signs. It should be mentioned that several-point characters with a characteristic shape are recognised faster (Grzegorzewska, 1927). Other factors include the structure of the text (occurrence of words and pseudowords, length and repetition of words) and the type of writing code used (integrals, abbreviation system).

The initial phase of the reading process for blind and sighted children is similar. The child's concentration on the act of letter recognition affects the incongruence between the pace of the sensory and the mental segment, which leads to errors in reading (confusion, rearrangement, guessing of letters and words), and this results in reading without comprehension (Bendych, Nowak, 1985). Educational practice demonstrates that blind students at the early childhood education level can, on average, achieve the same reading speed and fluency as their sighted peers. In doing so, they are highly motivated to gain proficiency in writing and reading.

In the later stages of education, the difference in reading speed between blind and sighted students increases. Blind pupils have approximately three to four times slower speed. By mastering the speed reading method, speeds of up to 225 words per minute can be achieved without loss of reading comprehension (Bendych, Nowak, 1985). Because of the lack of differences between the visual and tactile structure of reading, as proved by M. Grzegorzewska (1927), and the child's tendency to formally apprehend reality (objects), it is reasonable to base the teaching of reading on a holistic method, which is conducive to increasing the speed of reading.

Braille writing is done using a braille slate with a chisel and/or a braille machine and related devices (e.g., an electronic braille notepad). Two rules must be applied when writing in the slate: the direction of the embossed characters from right to left and the opposition (axial symmetry) of the punched characters. The prerequisites for meeting these requirements are the ability to orient and transform small spaces, motor coordination of both hands and manual dexterity. Operating the keyboard

of a machine or a Braille notepad is much simpler. Writing on these devices does not require the mental operation of character transformation and allows simultaneous control of the written text. The writing technique is chosen to suit the individual student's circumstances and needs, although it is recommended that they master both. It is important to remember that the process of teaching the Braille system and Braille techniques, as well as the educational process based on them, should be implemented using materials prepared according to the developed principles available on the websites of the Ministry of National Education and the Centre for Education Development.

Assessment of the effects of teaching the Braille system needs to be based on standardised tools, an example of which is *Kwestionariusz oceny umiejętności związanych z czytaniem pisma Braille'a* [The Braille reading skills assessment questionnaire] by Joanna Witczak-Nowotna and M. Paplińska (Witczak-Nowotna, Paplińska 2003).

However, it should be noted that in Poland, Braille initiation at the stage of preschool education (especially in the inclusive system) is not common. Starting to learn the Braille system together with early childhood education is a difficult situation for the child, not conducive either to the effectiveness of mastering Braille writing and techniques or to achieving educational success. Nevertheless, the goal of the rehabilitation and education of a child with a visual disability is his or her overall development, and learning to read and write tactilely is one of many means of achieving this. The start of Braille literacy should be made as early as possible, but on the condition that the child has satisfactory mastery of verbal speech and has reached the necessary level of psycho-physical and intellectual maturity.

Contemporary and prospective use of the Braille system

Information and communication technologies have made changes to the morphology of the Braille system and provided it with new value. The modern variant of the system is the so-called "eight-point computer Braille" – *Eurobraille*. When working with a computer, the Braille system is a temporary representation of the characters displayed on the screen. Computer technology offers the full possibility of text correction. It allows publications stored on digital media to be read in braille, which is particularly important for multi-volume publications. Through the use of a scanner and braille printer, it allows any black and braille text to be reproduced multiple times. It replaces the traditional postal mailing of Braille volumes through the use e.g., of email.

An example of contemporary use of braille is the DAISY (Digital Accessible Information System) digital book. Of its six standards, the use of Braille is categorised:

- full recording with a navigation system and part of the text – gives full access to the structure of the book (there is a part of the text synchronised with the recording in the publication, which enables the use of search tools);
- full recording and full text – the most complete use of the DAISY format, it is possible to navigate through the book linearly and hierarchically, visually impaired people can read on a computer screen and print out in Braille, the text is synchronised with the recording, which makes it possible, for example, to learn foreign languages;
- full text and part of the recording – a format particularly useful for the preparation of dictionaries and foreign language textbooks;
- full text without recordings – a format used primarily for printing Braille books and reading by the visually impaired or speech synthesiser.
- An important tool for working with braille text is the OBR (Optical Braille Recognition) system, which converts braille text to plain text. It is used for re-editing, reprinting and storing braille original texts (Jakubowski, 2001).

The Braille system and computer technology are used in the production of tiffographs, i.e., convex drawings, plans of objects and cities, mock-ups, maps, and atlases. In colour tactile maps, a system of one- and two-letter abbreviations is used, preceded by keys, to distinguish the categories of objects described in this way. These abbreviations are simplifications of proper names, requiring abbreviation due to the space taken up by the Braille system (e.g., Olczyk, 2016).

The braille system has applications in assistive technologies: mechanical devices (e.g., mechanical braille machines), braille microprocessor devices (braille keyboards, electronic braille machines, braille text conversion software, braille label printers, industrial and personal braille printers, braille monitors – braille rulers, electronic braille notepads).

The functionality of the Braille system is also expressed in its application to school supplies and aids. These include, for example, Braille slates and styluses, rulers, eccentrics, protractors, callipers, tactile globes, Mountbatten Brailler, rotary key rings for Braille learning, cubarithms, Braille stickers for keyboards, Braille paper, relief maps, city and site plans, geographical and anatomical atlases, everyday devices (e.g., Braille carpenter's measure, Braille centimetre, DymoQueen – Braille labels, Braille watches), games for the blind (e.g., Braille marked cards, Braille checkers, Braille chess) (Czerwińska, 2019).

As mentioned above, the situation of Braille in the field of education (especially inclusive education) for children and young people with visual disabilities and the laws of the media revolution make it possible to foresee changes in the functionality of the system and the material characteristics of books for the blind. A radical reduction in the publishing of Braille books and periodicals is forecast.

Braille publishing will only be used in early childhood education and in learning the system. The Braille system will be used by blind people mainly in computer work and everyday life situations (e.g., labelling of food packaging, household chemicals, cosmetics, medicines, etc.). Digital Braille (Eurobraille) will be used for reading electronic publications using Braille assistive technologies. The primary form of books for the blind will cease to be paper books and will become digital books (Czerwińska, 2019).

The parental and educational importance of the Braille system – guidelines for parents and educators

The developmental task – mastery of literacy – in the case of students with profound visual disabilities is conditioned by personal resources (e.g., level of intelligence, possessed visual potential, degree of tactile sensitivity, health condition, emotional-motivational processes) and environmental factors (e.g., availability of materials in alternative formats, presence of specialists, including Braille teachers, degree of use of modern technologies, family situation). The attitude of teachers and parents, their awareness of the importance of the Braille system in the psychosocial functioning of people with profound visual disabilities, remains crucial.

The Braille system is of fundamental educational and upbringing importance, as pointed out by educators and teachers as early as by Mother Elżbieta Róża Czacka, who formulated the principles of the Laski Institutes for the Blind (e.g. Czacka, 1934, 2008). The Braille system conditions the acquisition of literacy skills, i.e., access to the written word, mastery of the rules of spelling, punctuation, grammar of the mother tongue and foreign languages, makes it possible to familiarise oneself with the layout of the text on the page, makes sources available: text, mathematics, physics, chemistry, IT, music, graphics, prevents secondary illiteracy, gives independence in everyday life (performing self-service activities, running a household, orienting and moving in space), creates equal educational and professional opportunities, allows participation in social, scientific, technical and cultural life (Paplińska, 2016b, Czerwińska, 2019). The Braille system therefore serves not only inclusive education but also the process of education (in the family and educational and rehabilitation institutions), leading to independence and self-reliance, which are at the base of social inclusion.

Unfortunately, there is less and less interest in the teaching and use of the Braille system, due to a perception of the time-consuming process of acquiring point writing skills, slower reading speeds, the need to master complex specialised notation, a lack of teacher competence to teach the alphabet (particularly in mainstream schools), a preference for listening techniques and screen reader technology (e.g., freely available NVDA) overprint,

perceived as a faster way of obtaining information. Parents, unaware of the importance of the Braille system for their children's educational and psychosocial functioning, also succumb to these opinions.

The tendency, symptomatic of inclusive education, not to attach importance to Braille literacy training, and thus the use of Braille techniques and materials by students with visual impairments and their teachers, should be of concern. Research indicates a lack of familiarity with Braille notation among teachers in mainstream and inclusive schools (Czerwińska, 2019).

Teachers who are unprepared tyflodidactically and uninformed parents support the increasingly widespread belief among visually impaired students that it is acceptable to replace reading and writing skills with memory-based, verbal learning methods, and the use of reading aids, which leads to illiteracy (Jakubowski, 2005). Making the inclusive education of visually impaired students solely based on the auditory channel (auditory retrieval of information and communication) contradicts the principles of tyflodidactics, limits cognitive development, and reduces the level of education and communication skills.

With the increasingly widespread use of new media, it should be noted, following Emilia Śmiechowska-Petrovskij, that: "the Braille system cannot be treated on an exclusive principle, as the only communication medium, but it is necessary to educate students in parallel to use diverse information and communication technology tools and systems" (Śmiechowska-Petrovskij, 2016, p. 122). It is therefore advisable to integrate Braille techniques and ICT and assistive technology solutions in the educational process from the preschool and early childhood education stages.

Given the above considerations, Paweł Wdowik's position, which regards the abandonment of the Braille system in the process of upbringing and education of visually impaired students as a manifestation of their discrimination and stigmatisation, is correct. In his justification, the author emphasises the stimulating role of teaching the Braille system already in kindergarten for the child's cognitive and psychomotor development, increasing, thanks to the use of the Braille system, the child's independence in the whole educational process and thus increasing the child's self-esteem, better integration with the peer community thanks to the use of the same textbooks and performing the same tasks, greater independence in professional life of visually impaired persons using the Braille system (Wdówik, 2010).

The postulates relating to practical activities become particularly important in light of the degradation of the use of the Braille system in the process of upbringing, education and the everyday life of visually impaired people. It is necessary to generalise a system of early development support for young blind children, incorporating Braille reading initiation, i.e., preparation for learning the Braille system.

Parents should be involved in these activities. Wanda Szuman's appeal is still relevant: "Remember, Mother, Father, that it depends on you whether your child will be more skilful

and wiser, freer with each day, or whether he will participate in life immobile, in one place, passive, idle, bored, and lonely" (Szuman, 1961, p. 5). Parents, despite their unfamiliarity with the Braille system, should be the first teachers for their visually disabled children. Their role is to awaken the child's interest in books, relief print, and tactile graphics.

Bożena Kazanowska emphasises

> [...] the complexity of the impact of tactile books on the development and functioning of the young blind child, which includes, among other things, the development of cognitive processes, manual dexterity, spatial orientation, and the emotional sphere. These books activate touch and stimulate attention, thinking, memory, and imagination. Books are a source of the earliest knowledge about objects and phenomena in the child's immediate and distant environment. They encourage the production of judgements about their meaning and train all the skills associated with the mechanical side of tactile reading. They are a source of joy and fun for every child (Kazanowska, 2012, p. 97).

Tactile books are used to make the child aware of the possibilities and scope of using touch to explore the surrounding reality, to encourage active exploration of the environment (especially tactile), to focus attention on tactile stimuli, and to prepare them to read Braille signs (especially when Braille texts accompany convex, multi-faceted illustrations). Reading them together strengthens intra-family integration and becomes a platform for the child's contact with parents and grandparents and natural play activity with siblings (Czerwińska, 2015).

The task of kindergarten teachers is no longer to maintain the interest in tactile books and the Braille system, awakened by parents, but above all to work in a planned way to properly prepare the child for learning to read and write in the Braille system (Paplińska, 2012a). Teachers of visually impaired students (especially in mainstream education) should be required to have a good degree of didactic preparation, including knowledge of the Braille system and its teaching methodology, use of Braille and tiffographic materials in the educational process, and use of Braille assistive technologies.

Conclusion

The issue of literacy for students with visual impairments is constantly expanding. Considering the dynamic changes in the educational and social space (growing popularity of non-segregated forms of education, increase in the number of blind and partially sighted students with combined disabilities, technological progress), there is a growing need for further research and practical solutions in the area of the mentioned issues.

Writing for the blind, including the Braille system, remains a continually fascinating subject of mono- and interdisciplinary research, e.g., bibliological and tile studies (e.g., Czerwińska, 2017, 2019), neurodidactic and tile studies (Paplińska, 2022), tile studies, psychological and neurobiological studies (e.g., Czarnecka et al., 2023).

It is important to conduct nationwide research on the reading and information culture of different age groups of visually impaired people, with a particular focus on Braille reading and the use of the Braille system for information acquisition, processing and production. Research on the diversity of non-educational use of the Braille system by people with disabilities, taking into account sociodemographic variables, could prove useful in rehabilitation practice.

From the perspective of tyllopsychology, tyllopedagogy and reading psychology, it would be advisable to study the reading process, considering its phases: perception (reception of the text using the sense of touch and processing of tactile information by the brain), reception (understanding of the read text and embedding it in the individual's system of values and knowledge and memorisation), internalisation (adoption and acceptance of the views contained in the text), and exteriorisation (putting them into practice and convincing other people of them) (*cf.* Czerwińska, 2019). Research into the presence of the principles of Joanna Konarska's (2010) concept of rehabilitative education in the educational behaviour of parents of visually impaired children and the place of Braille reading initiation in it may prove important for the practice of tylfopedagogy. Comparative studies of the Braille system with other convex alphabets may prove interesting: convex Moon linear writing, Fishburne alphabet, and ELIA alphabet.

A prerequisite for the continued functionality of Braille and against its elimination from the psychosocial functioning of visually impaired people is its promotion in the wider context of social and educational policy, following the concept of social inclusion and inclusive education.

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