Neurological Approaches in an Inclusive Educational Environment: Effectiveness of Support for Children with Speech Disorders

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Abstract

Objective: The study aims to determine the role of neuro-speech therapy in correcting speech disorders within inclusive education through an analysis of global experience and to develop practical recommen-dations for applying neuro-speech therapy approaches in inclusive settings. **Methods:** The research is based on general scientific methods, including induction and deduction, as well as systematization, bibli-ographic review, and analytical approaches. These methods were used to examine international scientific literature and to identify current trends and gaps in the application of neuro-speech therapy. **Results:** The findings reveal significant challenges related to inconsistent international terminology in the field of neuro-speech therapy, which complicates access to relevant information and limits effective knowledge exchange. In addition, there is a lack of comprehensive empirical research assessing the effectiveness of neuro-speech therapy interventions in correcting speech disorders. Despite these limitations, the analysis of scientific sources and practical experience allowed for the identification of key principles of neuro-speech therapy. Based on this, a set of recommendations was developed to support the implementation of these approaches in inclusive education. **Conclusion:** Neuro-speech therapy represents a promising direction for improving the correction of speech disorders in inclusive education. However, further research and standardization of terminology are required. The proposed recommendations contribute to enhancing professional practice among speech therapists, neuropsychologists, and educators working in inclusive environments.

Keywords: neurological speech therapy, sensorimotor stimulation, speech and language therapy, inclusivity, correction of speech disorders

1. Introduction

The extension of inclusiveness in education is a practical operation to promote social justice for handicapped persons based on equal opportunities [1]. However, trying to achieve such the aforementioned goals of hetero-geneous environments in actuality is challenging, particularly with regard to children with speech disorders. The connection of the neuropsychological and cognitive developments with the speech has also been proven, that is why today sensorimotor stimulation in speech acquisiton process is scientifically processed [2, 3]. How-ever, the researchers, despite the rather large number of publications on this issue or another neurospeech tool's effectiveness analysis when using most authors agree that the assessment of the effectiveness of neuro-speech therapy tools is based mainly on questionnaire responses specialists in speech correction and not on changes in scale development. This results in the search for a science base to development of neuro-speech therapy as well as patterns of successful application of thereof based on international experience. This served as the basis for urgent search and generalization of world experience by world community in neuro-speech therapy at formation of recommendations on core principles of technique correction different form of speech pathology in a method correctible with application's neyro-speech methodology.

2 Literature Review

The rights of people with special needs to reach full-fledged learning are in fact the principles of the sus tainable development goals and the development vector, access and equity in the community where inclusive education

provides access, accessibility. In general, however, agreement was reached at the UNESCO conference 1994 about the need to promote inclusive education, but the road to accomplishing that has been more difficult than expected [4]. Moreover, it is also difficult to assess the performance of the countries when moving towards inclusive education due to the lack of common quality standards [5, 6]. This observation by the success of the inclusiveness in the education system that how educational institutions acts with pro-vision that how they can have the involvement of special category that is of limited mobility, visual disability, and hearing impairment child. While these are workforce intensive and incur economic costs [7], And surely it is speech that of methods to students with special needs as much has and tried of incorporating interact with them of environment. When it comes to actual integration with the process of studying, it becomes a hard job for a teacher to do, but it requires a good methodology and differentiation in teaching [8]. It is thus the teachers' explanation and they often resort to IT to do this, since the IT tools help them to on load part of these tasks on automation, which gives benefits in time to work with personalized education [9]. That is the reason why e-inclusive pedagogy creates flexible and effective learning environment where students with SEN can reach their academic potential or get prepared for life. Contemporary AI and machine learning are useful student's speech problems solving tools, which help to develop their reading, writing, pronunciation and text understanding [10]. In addition to e-inclusive pedagogy, gamification can be another field, which can enhance the motivation of students with special education needs and can help in personalized learning [11]. Although it is true that the number of integrated into the education process children has considerably in-creased, and in addition, children with disabilities receive more teacher's and parents' attention and support, as well as the support from peers, but the speech disease creates a hindrance for the process [12, 13]. Wren et al. [14] underscored that not only did children with speech disorders fail to perform at their peers' level in the core curriculum, but they also struggled with interaction and communication with their peers and teachers. Thus, the study of the problem of speech diseases should become a topic for a special collaboration with a range of researchers: speech therapists, neurobiologists, psychologists, and linguists [15]. Taking into consideration the fact that speech underlies genetics and environment and that does not develop ideally in both cases, there can be association with such genes as mutated versions of genes FOXP2, SETBP1, SETD1A DDX3X; most often these mutations are acquired, rather than inherited and it has a good prognosis for correction and treatment [16] as well as this is caused by genetic heterogeneity the way it is typical for many other neurodevelopmental communication disorders, and even in the mild form of diseases, such as phonemic ones, the speech is supervised by brain biological activity that in its turn depends also upon social factors [17]. In their work, speech therapists encounter the fact that traditional physical exercises without neuromodulation are ineffective [18]. Hence, neuro- speech therapy techniques sound appealing both in treating the disease and neuromodulating the student to the life in the school. The aim of the study was to determine the role of neuro-speech therapy approaches in correcting speech disorders worldwide and to develop recommendations for their implementation in inclusive education.

3 Materials and Methods

For collection of information, a literature review were performed and extracts from these scientific metric databases of the articles such as PubMed, Google scholar and DOAJ (Directory of open access journals) which target on therapeutic accomplishments that are related to clarification made by the process of speech making. This study is also an analysis of the quality and quantity of articles in scientific journals between 2021-2025. Recommendations were developed for groups of logopedists, corrective psycholohists and teachers working with the patients on the basis of inductive, deductive, comparative analysis and systematization. The conclusions of the studies were presented graphically, with respect to facets of both general problems and achievements in the international science on this issue.

4 Results

To determine the international experience in the application of neuro-speech therapy techniques for the treatment of speech disorders, data from the open scientific and metric databases Google Scholar, PubMed, and Directory of Open Access Journals for the period 2021–2025 were analyzed. We identified problems with the

terminology of the term “neurologopedia,” which has no equivalent in English, as evidenced by the fact that there were only 80 publications in Google Scholar, 6 in PubMed, and 1 in DOAJ. Most of these articles were written in Polish or Ukrainian, or by authors from other Eastern European countries who used this term in their English-language publications. Moreover, the term “neurologopedia” was combined with the keywords ‘children’ and “speech therapy” in more than 50% of cases (Figure 1).

Figure 1: Use of the term “Neurologopedia” in scientific articles for the period 2021–2025 Source: created by the author based on data from open databases of scientific articles Google Scholar [19], DOAJ [20], PubMed [21]

However, a literal translation of the term “neurologopedia” – “neuro speech therapy” in Google Scholar occurs in about 1,000 articles and does not contain much information specific to neuro-speech therapy approaches, as it is mainly associated with neurology in general. For a more effective search for scientific information, the words “children” were additionally used, which did not narrow the search, but on the contrary added articles that were not related to the field of neuro-speech therapy. The lack of advanced search options on this platform makes it practically impossible to find specific information on neuro-speech therapy approaches due to the large number of articles associated with these search terms. In the DOAJ and PubMed search engines, which offer advanced keyword search options, we were able to narrow down the search (Figure 2). However, even after refining the data related to children, only 6 of the 11 articles in DOAJ were associated with neuro-speech therapy, 5 of which were related to artificial intelligence and other IT technologies used to treat speech disorders. In the PubMed database, the number of articles related to neurospeech therapy in children accounted for 22.66% of the total number of articles with the keywords “neuro speech therapy,” which indicates the relevance of this area in pediatric speech therapy. Analyzing the main areas related to the above keywords, we observed an increase in publications related to the use of artificial intelligence and other information technologies to overcome speech problems. Therefore, we performed an extended search with the query “Artificial intelligence / IT technologies” to identify current achievements in this field. At the same time, narrow-profile articles on neuro-speech therapy approaches were mostly related to the use of IT technologies in neuro-speech therapy. For a more detailed analysis, we searched for articles from recent years based on the basic principles and approaches of modern domestic neurospeech therapy. Among the main principles, we identified the stimulation of sensorimotor functions, namely the development of motor planning, the correction of coordination movements, and proprioceptive sensitivity. The search for articles using the query “speech and language therapy/children/sensorimotor stimulation” is shown in Figure 3.

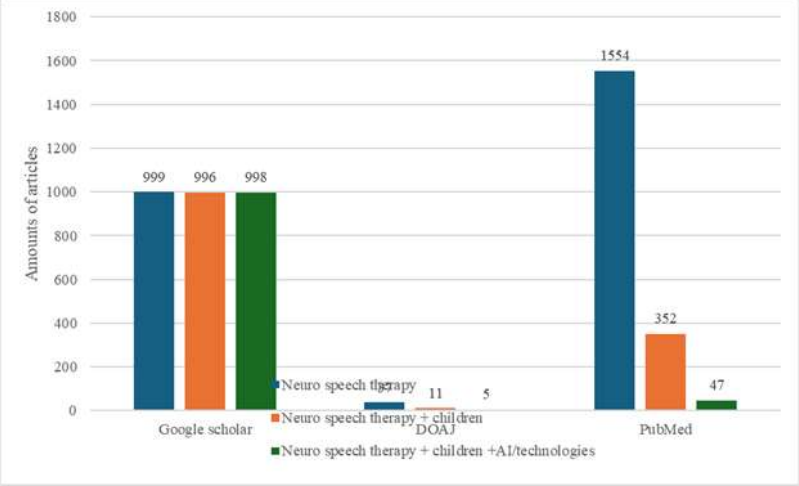

Figure 2: Search results for articles on “Neuro speech therapy” in scientific metric databases for the period 2021–2025 Source: created by the author based on data from open databases of scientific articles Google Scholar [19], DOAJ [20], PubMed [21]

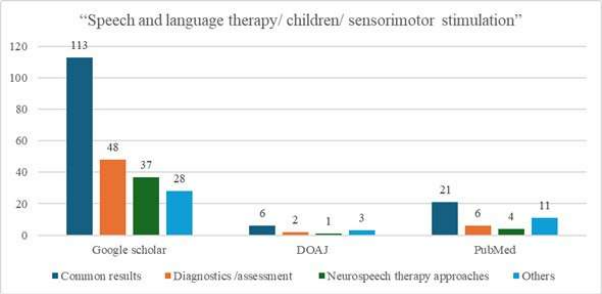

Figure 3: Results of searching for articles on the query "Speech and language therapy/children/sensorimotor stimulation" in scientific metric databases for the period 2021–2025 Source: created by the author based on data from open databases of scientific articles Google Scholar [19], DOAJ [20], PubMed [21]

The results of the advanced search revealed articles that mostly relate to the field of neuro-speech therapy, but more than a third of the articles in this list are not related to the topic under study. Among the articles on neuro-speech therapy, approximately 50% are devoted to the diagnosis of neurological status and speech disorders, the assessment of sensorimotor development, and the effectiveness of the proposed scales for assessing speech, sensorimotor, or behavioral development. However, there are insufficient recommendations regarding neuro-speech therapy approaches for correcting deviations. This creates the preconditions for the development of this field of study, the creation of a professional international community for the exchange of experience, and the creation of unified protocols for neuro-speech therapy correction of speech deviations. Based on an analysis of publications and our own experience, we have created a list of recommendations for neuro-speech therapy exercises and principles that contribute to the correction of speech disorders. Among the principles, it is important to adhere to a clear correction plan, taking into account susceptibility to exercises; combine different types of exercises and aids; apply a systematic number and frequency of exercises during classes; adhere to the continuity of the correction process; use repetition of exercises; alternating exercises for motor planning, coordination development, and balance maintenance, stimulating proprioceptive and audiovisual sensitivity; involving parents and other specialists in performing tasks. Based on current international achievements, it is recommended to include a measured amount of exercises using telemedicine and artificial intelligence programs. To systematize and structure the lesson, we identified types of neuro-speech therapy approaches that help stimulate speech centers by acting through the mechanism of stimulating sensorimotor centers associated with speech development:– game strategies; – audio stimulation; – development of gross and fine motor skills; – behavioral therapy; – visual-motor stimulation; – development of fundamental motor skills; – development of coordination and precise movements; – development of equilibrium and balance, stimulation of the vestibular apparatus; – development of rhythmic movements; – development of planning skills; – socio-psychological adaptation. After analyzing recent literature reviews on the use of neuro-speech therapy approaches in speech patholo-gies of various etiologies, we found that most studies are related to game strategies (1,043 studies), audio stimulation – 427 studies, and behavioral therapy – 103 studies [22, 23, 24, 25]. However, some studies have shown that children with speech disorders have problems with gross and fine motor skills, balancing skills, and visual-motor perception [26]. Therefore, recommendations include stimulating the development of fine motor skills in inclusive educational institutions, namely by involving specialists in occupational therapy. However, the above-mentioned literature reviews demonstrate gaps in the definition of effective neuro-speech therapy approaches and the lack of a systematic approach in this area of research. One of the components in neuro-speech therapy exercises is to acquire a natural movement, which guarantees a concise and smooth implementation by the therapist during the session. Such natural movements may involve breathing exercises and muscle stretching, which stimulate blood circulation, return the psycho-emotional state to norm and help in eliminating stress [2]. Natural movements also consist of walking, eye morons, and reenactments in addition to your own base position (the lowest component of the session). Next part of the treatment will be dedicated to physical awareness, working from massage, self-massage through balance exercises and development of vestibular system. This workout provides the child to concentrate, thus becoming more confident, and release stress. Verbal support, including poetry, music and possisbly video exercises are an

important part of these workouts. Add some rhythm/coordination/balance exercises to play. So as not to make wrong moves and regress the progress, it is helpful if the child holds a ribbon with one hand. The ribbon ought to be on the same hand each day. It is also recommended for the parents' homework to perform exercises on the ribbon. Another key point is to do the exercises in a playful attitude, and refrain from giving many comments [27]. The child should be praised more for exercises that made them perform better and not so much for the ones that did not succeed to give confidence in his accomplishments and stimulate participation. It is recommended to use exercises with a ball, art therapy (the tasks aimed at the formation of fine and rough motor skills, that contribute to inter- hemispheric interaction formation and coordinated activity of visuomotor centers), audio methods. Crossing from one hand or foot to another side of the body aids spatial orientation and motor planning. Exercises in procedure to perform stereotypical processes that correspond with the simplest reflexes may be learned on examples of simulated behavior. Fairy tales, audio and video materials can act as models of behavior. It is crucial to limit supports and rather focus on the dynamic interaction between expert and child. In collective classes it is necessary to be guided by age and the level of psycho-emotional and behavioral development. Single lessons should also be taught emphasizing these principles in anticipation of the beginning of complex exercises as for the development speech motor skills, phonemic differentiation and production and expanding vocabulary. A set of neuro-speech therapy exercises helps activate speech centers by stimulating sensorimotor centers, so it's a good idea to do them during class. On the other hand, it's best to end class with simple relaxation exercises to relieve fatigue and leave students with a positive emotional impression after class. To this end, it is worth limiting the duration and frequency of classes. It is advisable to consider the possibility of remote classes with the involvement of parents and teachers to maintain the continuity of the process. Another positive result is the impact of neuro-speech therapy exercises on behavior and psycho-emotional state, which are the basis for the formation of speech skills. That is why it is advisable to introduce neuro-speech therapy exercises into regular classes in inclusive classrooms, which will have a positive effect not only on children with speech disorders but also on typical students. Neurological speech therapy exercises promote concentration, relieve psycho-emotional tension, and improve cognitive abilities. Another important aspect is maintaining achievements by creating favorable conditions for correction, namely, adhering to a daily routine, nutrition, and sleep, as well as avoiding stressful situations.

5 Discussion

Neuro-Language Therapy is a key part of speech therapy. From methods of arousing the nervous centers to remove defects in speech. Sensory-motor stimulation is particularly crucial for children in speech recovery. For children somewhere between 5 and 12 years of age, it's motor regions of the brain that are involved in learning speech, whereas for somewhat older and oldest kids, it's the auditory sensory-motor cortex where they're learning to listen and speak [28]. We have recently shown a link between successful treatment of motor speech disorders (dysarthria and speech apraxia) and brain reorganization. Neuroimaging has confirmed this fact [29]. Despite the fact that speech therapists are increasingly using sensorimotor interventions in their practice and reporting positive results from such interventions, there are still few publications and studies proving the effectiveness of such interventions [30]. Moreover, our study revealed gaps in the existence of professional unified terminology in the world, which complicates the search for specific literature. Recent studies have mostly focused on the diagnosis and assessment scales of speech development [31, 32]. However, the number of publications of scientifically based recommendations and evidence of the effectiveness of individual neuro-speech therapy approaches or sets of neuro-speech therapy exercises in the public domain is limited. This creates the conditions for the adoption of unified terminology, in particular the introduction of the term neuro-speech therapy into English-language terminology, as this will allow for the identification of professional vocabulary and simplify the search for a given topic. Studies on the effectiveness of neuro-speech therapy exercises are mostly based on surveys of speech therapists, but there are no freely available studies based on comparisons of achievements according to international speech development scales. Instead, recent research trends in neuro-speech therapy approaches are focused on the use of artificial intelligence, telemedicine, and machine learning to perform neuro-speech therapy exercises [33]. Recommendations have been developed based on international and personal experience, which are of prac-tical importance for speech therapists, inclusive classroom teachers, and neuropsychologists. Since speech development is the basis for the social adaptation of people with special needs, and neuro-speech therapy exercises also have a positive effect on behavior and psycho-emotional state, these recommendations con-tribute to the creation of a fair and inclusive

educational environment. We envisage further research into the effectiveness of neuro-speech therapy measures based on a comparison of the results of speech disorder correction in accordance with international speech development scales.

6 Conclusions

The results of the study revealed problems with narrow-profile terminology related to neuro-speech therapy approaches in international scientific literature, which made it difficult to find information on this topic. Weaker side was also absence of the common recommendations and research on effectiveness of neuro-speech therapy that need to establish professional international community, share experiences, approve professional vocabulary, formulate standards for methods of neuro-speech therapy correction speech activity. On the basis of the data we obtained and our experience, certain provisions were formulated in a sequence concerning general aspects of the approaches to neurospeech therapy that are suitable for correction of speech disorders. These suggestions are of paramount significance for speech therapists, neuropsychologists, and also teachers from inclusive classrooms, because they contribute not only to the development of speech skills but also to a positive influence on behavior and psychic emotional state of students.

References

[1] Kim, U., et al. "Inclusive Education in South Korea." *Remedial and Special Education*, vol. 45, no. 6, 2024, pp. 339–350.

[2] Stephens-Sarlos, E., P. Stephens, and A. Szabo. "The Efficacy of the Sensorimotor Training Program on Sensorimotor Development, Auditory and Visual Skills of Schoolchildren Aged 5–8 Years." *Child & Youth Care Forum*, vol. 54, 2025, pp. 323–352.

[3] Ili´c-Savi´c, I., M. Petrovi´c-Lazi´c, and R. Resimi´c. "Sensory Integration and Its Significance for Function-ing and Development of Children's Speech." *Medicinski Pregled*, vol. 74, nos. 5–6, 2021, pp. 205–210.

[4] Nilholm, C. "Research about Inclusive Education in 2020: How Can We Improve Our Theories in Order to Change Practice?" *European Journal of Special Needs Education*, vol. 36, no. 3, 2021, pp. 358–370.

[5] Schwab, S. "Inclusive and Special Education in Europe." *Oxford Research Encyclopedia of Education*, Oxford University Press, 2020.

[6] Hernández-Torrano, D., M. Somerton, and J. Helmer. "Mapping Research on Inclusive Education since the Salamanca Statement: A Bibliometric Review of the Literature over 25 Years." *International Journal of Inclusive Education*, vol. 26, no. 9, 2022, pp. 893–912.

[7] Buchner, T., et al. "Same Progress for All? Inclusive Education, the United Nations Convention on the Rights of Persons with Disabilities and Students with Intellectual Disability in European Countries." *Journal of Policy and Practice in Intellectual Disabilities*, vol. 18, no. 1, 2021, pp. 7–22.

[8] Rasmitadila, R., M. A. Humaira, and R. Rachmadtullah. "Student Teachers' Perceptions of the Collaborative Relationships between Universities and Inclusive Elementary Schools in Indonesia." *F1000Research*, vol. 10, 2022, article 1289.

[9] Karagianni, E., and A. Drigas. "New Technologies for Inclusive Learning for Students with Special Educational Needs." *International Journal of Online and Biomedical Engineering*, vol. 19, no. 5, 2023, pp. 4–21.

[10] Ahmed, S., et al. "Advancing Personalized and Inclusive Education for Students with Disability through Artificial Intelligence: Perspectives, Challenges, and Opportunities." *Digital*, vol. 5, no. 2, 2025, article 11.

[11] Jadán-Guerrero, J., et al. "Gamification in Inclusive Education for Children with Disabilities: Global Trends

and Approaches—A Bibliometric Review." *Computational Science and Its Applications – ICCSA 2023 Workshops*, edited by O. Gervasi et al., Lecture Notes in Computer Science, vol. 14104, Springer, 2023.

[12] Qu, X. "Structural Barriers to Inclusive Education for Children with Special Educational Needs and Disabilities in China." *Journal of Educational Change*, vol. 23, no. 2, 2022, pp. 253–276.

[13] Griful-Freixenet, J., et al. "Exploring the Interrelationship between Universal Design for Learning (UDL) and Differentiated Instruction (DI): A Systematic Review." *Educational Research Review*, vol. 29, 2020, article 100306.

[14] Wren, Y., et al. "Educational Outcomes Associated with Persistent Speech Disorder." *International Journal of Language & Communication Disorders*, vol. 56, no. 2, 2021, pp. 299–312.

[15] Bernasconi, T., et al. "Rehabilitative Approaches and Prognosis for Acquired Motor Speech Disorders: Dysarthria and Dyspraxia." *Phoniatrics III*, edited by A. am Zehnhoff-Dinnesen, A. Schindler, and P. G. Zorowka, European Manual of Medicine, Springer, 2025.

[16] Kaspi, A., et al. "Genetic Aetiologies for Childhood Speech Disorder: Novel Pathways Co-Expressed during Brain Development." *Molecular Psychiatry*, vol. 28, no. 4, 2023, pp. 1647–1663.

[17] Prastyo, N. T. L., et al. "The Relationship between Neurological Activity and /r/ Phoneme Pronuncia-tion Disorders in a Neurolinguistic Perspective." *Journal of Innovative Research in Primary Education*, vol. 4, no. 3, 2025, pp. 1316–1324.

[18] Lyndina, Y. "Interdisciplinary Links of Speech Therapy for Individuals or Children with Special Needs." *Revista Romaneasca Pentru Educatie Multidimensionala*, vol. 14, no. 4, 2022, pp. 260–273.

[19] "Google Scholar." *Google Scholar*, https://scholar.google.com/. Accessed 22 Apr. 2026.

[20] "Directory of Open Access Journals (DOAJ)." *DOAJ*, https://doaj.org/. Accessed 22 Apr. 2026.

[21] "PubMed." *PubMed*, National Library of Medicine, https://pubmed.ncbi.nlm.nih.gov/. Accessed 22 Apr. 2026.

[22] Van, J., and R. M. Kubina. "How Occupational Therapists, Physiotherapists, and Speech and Language Therapists Can Benefit from Precision Teaching." *Tizard Learning Disability Review*, vol. 30, no. 1, 2025, pp. 38–43.

[23] Carvajal-Vargas, F., et al. "Systematic Literature Review of the Applications Development Aimed at Language Skills Stimulation in Children." *Navigating the Technological Tide: The Evolution and Challenges of Business Model Innovation*, edited by B. Alareeni and A. Hamdan, Lecture Notes in Networks and Systems, vol. 1083, Springer, 2024.

[24] Wauters, L. D., et al. "Behavioral Treatment for Speech and Language in Primary Progressive Aphasia and Primary Progressive Apraxia of Speech: A Systematic Review." *Neuropsychology Review*, vol. 34, no. 3, 2024, pp. 882–923.

[25] Garcia de Carvalho Laguna, G., et al. "Playfulness in the Early Stimulation of Children with Autism Spectrum Disorder: A Systematic Review." *Psychology, Health & Medicine*, 2025, pp. 1–17.

[26] Varuzza, C., et al. "Gross, Fine and Visual-Motor Skills in Children with Language Disorder, Speech Sound Disorder and Their Combination." *Brain Sciences*, vol. 13, no. 1, 2023, article 59.

[27] Hajesmaeel-Gohari, S., et al. "Digital Games for Rehabilitation of Speech Disorders: A Scoping Review." *Health Science Reports*, vol. 6, no. 6, 2023, article e1308.

[28] Ohashi, H., and D. J. Ostry. "Neural Development of Speech Sensorimotor Learning." *Journal of Neuroscience*, vol. 41, no. 18, 2021, pp. 4023–4035.