Integrating Technology and Innovative Pedagogies in Phonetic Education: A Systematic Literature Review

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ABSTRACT

Phonetics, a crucial subfield of linguistics, has seen substantial advancements, particularly in educational contexts. This systematic literature review aims to identify and synthesize emerging trends in phonetics research from 2019 to 2024, focusing on acoustic and articulatory phonetics, phonetic ear training, and the use of technological tools in teaching. By examining 15 key studies from an initial pool of Utilizing tools like Publish or Perish, with database Crossref (1000) and Google Scholar (500) and a total of 1500 (n=15) studies to explore how orthographic inputs affect L2 learners' speech perception, production, phonological awareness, and lexical learning. This review highlights significant advancements such as Communicative Pronunciation Teaching (CPT) and network-based learning modes, which have been shown to enhance phonetic instruction effectively. However, challenges remain, including the variability in access to technology and limited research on the long-term impacts of phonetic training. The findings suggested that integrating innovative pedagogical approaches with technological tools can significantly improve phonetic education, thereby enhancing language learning outcomes. This study underscores the importance of personalized teaching strategies and the need for further research into the long-term effects of phonetic training, aiming to contribute to the development of more effective and accessible phonetic learning methods. The implications of this research extend beyond phonetics, suggesting that similar integrative approaches could be beneficial in other areas of language education, thus promoting better educational outcomes on a larger scale.

Keywords: Phonetic education, Technological integration, Communicative pronunciation teaching, Systematic literature review, Language learning

INTRODUCTION

Phonetics, a pivotal subfield of linguistics, has undergone significant evolution, especially in the context of teaching and learning. This area of study focuses on the sounds of human speech, encompassing their production, acoustic properties, and auditory perception. Recent research highlights the importance of integrating technological advancements and innovative pedagogical approaches to enhance phonetic education. However, there remain gaps in effectively implementing these advancements in diverse educational settings, highlighting the need for comprehensive reviews of current trends and practices.

The objective of this systematic literature review is to identify and synthesize emerging trends in phonetics research from 2019 to 2024. The study aims to provide insights into recent developments in acoustic and articulatory phonetics, phonetic ear training, and the use of speech organs for sound production, as well as the integration of computer-assisted learning and network-based teaching modes (Ashby, 2020; Lewandowski & Jilka, 2019). By

examining 15 key studies selected from an initial pool of 1500, this review seeks to highlight significant advancements and ongoing challenges in the field.

One notable gap in current research is the limited exploration of the long-term impacts of phonetic training and the role of individual learner differences in phonetic acquisition. Additionally, while there is substantial progress in technological integration, the variability in access to and quality of these technologies across different educational contexts poses a significant challenge. This review emphasizes the need for continued investigation into how technological and pedagogical advancements can be leveraged to improve phonetic learning outcomes.

The novelty of this study lies in its systematic synthesis of recent trends and the emphasis on practical applications of phonetic research in educational settings. The findings suggest that innovative pedagogical approaches, such as Communicative Pronunciation Teaching (CPT), significantly enhance phonetic instruction by combining explicit phonetic instruction with practical, meaning-focused activities (Nguyen et al., 2021; Nowacka, 2022). Moreover, technological tools, such as computer-assisted learning systems, provide interactive and effective pronunciation training, offering immediate feedback and extensive exposure to native pronunciations (Wang & Zhou, 2019).

However, this review is not without limitations. The scope is restricted to research published within a five-year timeframe, potentially overlooking relevant studies outside this period. The reliance on specific keywords and databases for literature search may have excluded pertinent research that uses different terminologies or is indexed in other databases. Additionally, the qualitative nature of content analysis may introduce subjective biases in interpreting the data, despite efforts to ensure consistency and rigor.

In conclusion, this systematic literature review presents a comprehensive analysis of emerging trends in phonetics research, highlighting the critical role of technological integration and innovative teaching methods in phonetic education. The findings underscore the evolving nature of phonetics research and its vital role in improving phonetic instruction, thereby contributing to enhanced language education outcomes. Future research should focus on personalized teaching approaches and the long-term impacts of phonetic training, ensuring the continued advancement of this essential field of study (Fan et al., 2023; Ali et al., 2023; Al-Mansoori et al., 2024; Ashby, 2020; Istiqomah et al., 2021; Lewandowski & Jilka, 2019; Nguyen et al., 2021; Nowacka, 2022; Rizkiyah & Ahmada, 2021; Tyler, 2021; Wang & Zhou, 2019; Zokirov & Zokirova, 2020; Yishake et al., 2020; Zhang, 2020).
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METHOD

Relevant research papers will need to be collected and categorized in their respective discipline "areas", and the solutions and recommendations of each will be characterized. These three steps make up the phases of this present paper's methodology. The whole process is illustrated in Figure 1.
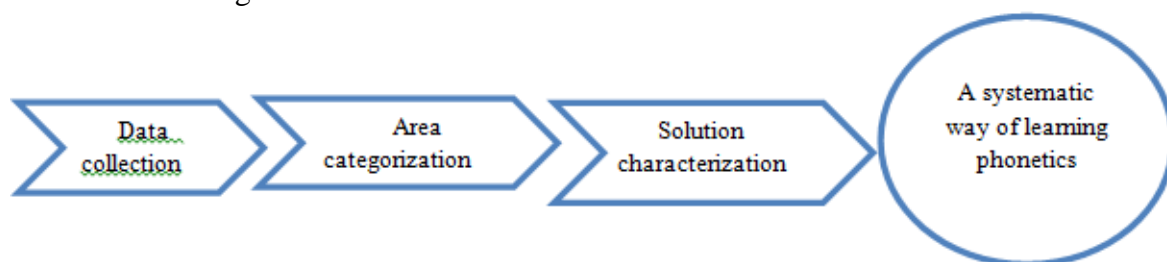

Figure 1. Sequences of Research Methods

The study was designed as a systematic literature review using two different types of research tools. The first tool is Publish or Perish, to automatically searches through multiple databases to present keyword-based search results. The advantage of this software is that it can provide hundreds of citations, therefore this research uses Publish or Perish to collect as much research as possible regarding phonetics published from 2019 to 2024 using the keywords 'phonetics', 'students', 'speech analysis', and gradually included other terms found such as 'teaching-learning', 'pronunciation', etc. Raw data collection amounted to 1,500 studies.

The purpose of this present study is to develop a comprehensive and easily accessible phonetic learning method for students, increase students' understanding of the production, perception, and analysis of language sounds, and improve students' practical skills in pronunciation and phonetic analysis. The approach is focused on using a combined approach that includes articulatory, auditory, acoustic, experimental, practical, and computational aspects. The expected results are students have a strong understanding of phonetic theory and practice, increased students' abilities in the production and analysis of language sounds, students are able to use tools and technology to support phonetic learning. It is hoped that the development of a comprehensive phonetics learning method can help students overcome difficulties in learning phonetics, as well as improve their understanding and practical skills in this field.

Table 1. Data Exclude and Include Criteria

Include	Exclude
Full text	Non-full text, chapter of book, book, systematic literature review
2019-2024	<2019
English	Non-English
Study focus phonetics students	Students are not focused on phonetics.

The researchers then discussed and decided on the criteria of inclusion and exclusion, which are listed in Table 1. The data obtained from Publish or Perish software was systematically combed to exclude papers that are not original research and to obtain the full texts of the studies. The process of elimination is depicted in Fig. 2. The final data collection was 15 studies on phonetics published from 2019 to 2024 (five years). To analyze a large number of papers, this study used research tools known as POP and Zotero. Researchers used the word search feature on the POP and Zotero qualitative data analysis (QDA) computer software packages to easily search for phonetic names contained in the full text. Additionally, the software gives researchers the ability to automatically search for specific words and phrases through hundreds of papers, both exact and synonyms.

To analyze paper data collection, researchers used chat PDFs. This study encodes the identified terms into nodes containing all references to a particular type. These references were further analyzed to categorize them into their respective disciplinary "fields," and the solutions and recommendations from each field were characterized. These steps form the methodological phase of this paper for studying a multi-faceted solution across disciplines that takes into account all the disjointed descriptions of previous researchers to build a consistent database of how college students learn and understand phonetics.

FINDINGS AND DISCUSSION

FINDINGS

The study searched two databases with Publish or Perish using the keywords 'phonetics', 'students', and 'speech analysis', etc, with a total database of 1.500 and the finding (n=15). Table. 2 shows the number of screening papers, and Fig. 2 shows the total (n=15) authors, titles, journals, year, discipline, and research questions.
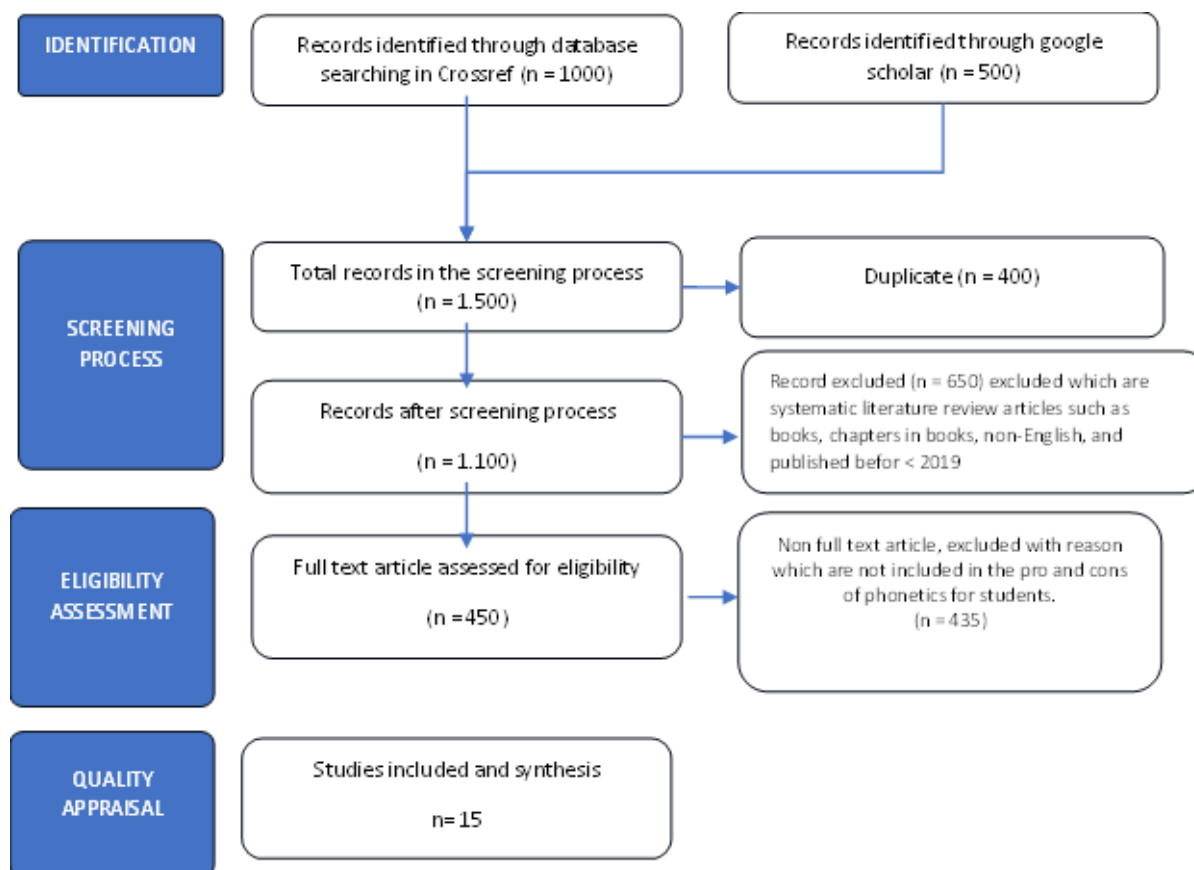

Figure 2. Diagram of the Data Selection Process

Table 2. General Description of the Included Article

No.	Author(s)	Title	Journal	Year	Discipline	RQ
1.	Fan Junying, Yang Lei, Mai Yinghong, Xu Yujun	Effectiveness of Automatic Speech Evaluation System in Improving Students' Self-efficacy in Oral English Learning	International Journal of New Developments in Education	2023	Education	How effective is the Automatic Speech Evaluation System in improving students' self-efficacy in oral English learning?
2.	Sri Widyarti Ali, Helena Badu, Nurlaila Husain, Fahria	English Phonetics and Phonology Learning and Its Impact on Students' English Pronunciation	Universitas Negeri Gorontalo, Indonesia	2023	Linguistics	What is the impact of English Phonetics and Phonology learning on students' English pronunciation?

	Malabar					
3.	Ahmad Faisal Al-Mansoori, Layla Khalid Al-Hassan, Tariq Jamal Al-Rashid	Classroom Activities and English Grammar Learning among Students	Research Studies in English Language Teaching and Learning	2024	Education	How effective is integrating games into grammar instruction for young learners?
4.	Patricia Ashby	Does Pronunciation = Phonetics? 100 Years of Phonetics in Pronunciation Training	Language	2020	Linguistics	What is the distinction between phonetics and pronunciation, and how have thoughts on this evolved over 100 years?
5.	Sri Ayu Istiqomah, Alies Poetri Lintangsari, Widya Caterine Perdhani	Attitudes toward English Phonetics Learning: A Survey on Indonesian EFL Learners	Journal on English as a Foreign Language	2021	Linguistics	What are the attitudes of Indonesian EFL learners towards English phonetics learning?
6.	Natalie Lewandowski, Matthias Jilka	Phonetic Convergence, Language Talent, Personality, and Attention	Frontiers in Communication	2019	Psychology, Linguistics	How do individual phonetic talent and psycho-cognitive IDs of speakers affect phonetic convergence in a second language setting?
7.	Loc Tan Nguyen, Bui Phu Hung, Uyen Thi Thuy Duong, Tu Thanh Le	Teachers' and Learners' Beliefs About Pronunciation Instruction in Tertiary English as a Foreign Language Education	Frontiers in Psychology	2021	Education, Linguistics	What are the beliefs of teachers and learners regarding pronunciation instruction in tertiary EFL education in Vietnam?
8.	Marta Nowacka	English Phonetics Course: University Students' Preferences and Expectations	Research in Language	2022	Education, Linguistics	What are the preferences and expectations of Polish university students of English after undergoing pronunciation instruction?
9.	Faiqotur Rizkiyah, Adib Ahmada	An Analysis of Indonesian EFL Teachers' and Students' Speech Acts in Teaching and Learning Process	Darussalam English Journal	2021	Education, Linguistics	What types of speech acts are produced by Indonesian EFL teachers and students in the classroom?

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10.	Michael D. Tyler	Phonetic and Phonological Influences on the Discrimination of Non-native Phones	Second Language Speech Learning: Theoretical and Empirical Progress	2021	Linguistics	How does attunement to the native language (L1) affect the discrimination of non-native phones in L2 learners?
11.	Yanwei Wang, Haisen Zhou	Study on the Network-Based English Phonetics Teaching Mode for English-Major Students	International Journal of Emerging Technologies in Learning (iJET)	2019	Education, Linguistics	What are the benefits of the network-based English phonetics teaching mode for English-major students compared to traditional methods?
12.	Mukhtar Turdaliyevich Zokirov, Sohiba Mukhtoraliyevna Zokirova	Contrastic Analysis at the Phonetic Level	Academic Leadership The Online Journal	2020	Linguistics	How can a comparative study of intonations in different languages help understand the phonetic level?
13.	Yanwei Wang, Haisen Zhou	Study on the Network-Based English Phonetics Teaching Mode for English-Major Students	iJET	2019	Education, Teaching	What is the technology as the object of the teaching experiment to show the significance of the model in learning?
14.	Caifuding Yishake, Mariya Mayituohuo, Aasma Saleem, Xie Lili	Difficulties and Countermeasures of Han Nationality Students in Learning Kyrgyz Phonetics and Letters	International Journal of Linguistics, Literature and Translation (IJLLT)	2020	Education	What is a good methode solution to students' problems in learning Kyrgyz language?
15.	Xiaomei Zhang	On English Listening Learning Strategies for College Students	Learning & Education	2020	Education	What are the strategies for teaching students to listen to English effectively?
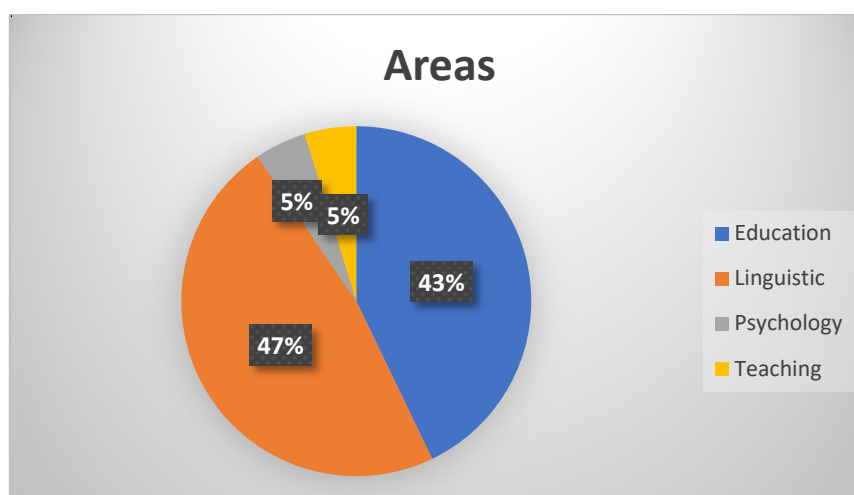
Figure 3. Percentage of the Discipline

The finding selecting data identified 1,500 studies focused on phonetics, from which 15 were selected based on specific inclusion and exclusion criteria. These criteria ensured that only full-text, English-language studies published between 2019 and 2024 were considered, with a focus on phonetics and student learning (see Table 1). This selection process excluded non-full-text documents, book chapters, and systematic literature reviews, as well as studies not directly related to phonetics (see Fig. 1 for the process diagram).

The final data set comprised 15 studies spanning various disciplines, including education, linguistics, and psychology, all contributing to the understanding of phonetics learning among students. For instance, Fan et al. (2023) examined the effectiveness of an automatic speech evaluation system in enhancing students' self-efficacy in oral English learning. Similarly, Ali et al. (2023) investigated the impact of English phonetics and phonology learning on students' pronunciation skills.

In analyzing the data, tools such as Publish or Perish, Zotero, and chat PDFs were utilized to systematically categorize the studies and extract relevant information. The software enabled researchers to efficiently identify key terms and phrases, facilitating a thorough review of the selected studies. The studies were then categorized into their respective fields, and their solutions and recommendations were characterized to build a consistent database on how college students learn and understand phonetics.

The following observations were noted: (1) Impact of Technological Tools: Several studies highlighted the positive influence of technological tools in phonetics learning. For example, the network-based English phonetics teaching mode (Wang & Zhou, 2019) was found to be more beneficial compared to traditional methods; (2) Students' Attitudes and Preferences: Research by Nowacka (2022) revealed that university students have specific preferences and expectations regarding phonetics courses, which can significantly affect their learning outcomes; (3) Role of Individual Differences: Lewandowski and Jilka (2019) explored how individual phonetic talent and psycho-cognitive factors influence phonetic convergence in second language settings, indicating the importance of personalized learning approaches; (4) Cross-Linguistic Studies: Comparative studies, such as the one by Zokirov and Zokirova (2020), provided insights into how understanding intonation in different languages can enhance phonetic learning at a fundamental level; and (5) Teacher and Learner Beliefs: Nguyen et al. (2021) discussed the beliefs of teachers and learners about

pronunciation instruction in tertiary education, emphasizing the need for alignment between instructional methods and learners' perceptions for effective learning.

The pie chart (Fig. 2) depicting the distribution of disciplines among the selected studies shows a balanced representation of education, linguistics, and psychology, underlining the interdisciplinary nature of phonetics research. This interdisciplinary approach is crucial for developing comprehensive phonetic learning methods that address various aspects of language sound production, perception, and analysis.

In conclusion, the systematic literature review highlights the multifaceted nature of phonetics learning, encompassing technological advancements, individual differences, and cross-linguistic comparisons. The findings underscore the need for an integrated approach that combines theoretical knowledge with practical skills, leveraging technological tools and personalized learning strategies to enhance phonetic education. By addressing these diverse aspects, the study aims to improve students' understanding and practical abilities in phonetics, ultimately facilitating more effective and accessible phonetic learning methods.

DISCUSSION

This study aimed to develop a comprehensive phonetic learning method to improve students' understanding and practical skills in phonetics. Through a systematic literature review, 1,500 studies were initially identified, and 15 were selected based on specific inclusion criteria (full-text, English-language studies published between 2019 and 2024, focusing on phonetics and student learning). Major findings from these studies highlight the positive impact of technological tools, the importance of understanding students' attitudes and preferences, the role of individual differences, and the value of cross-linguistic studies in phonetics learning.

The findings from this systematic review underscore the multifaceted nature of phonetics learning. The positive influence of technological tools, such as the network-based English phonetics teaching mode (Wang & Zhou, 2019), suggests that integrating technology can enhance phonetic education by providing interactive and engaging learning experiences. Understanding students' preferences and expectations, as highlighted by Nowacka (2022), is crucial for designing effective phonetics courses that meet learners' needs and foster better learning outcomes. The role of individual differences, explored by Lewandowski and Jilka (2019), indicates the necessity of personalized learning approaches to accommodate varying levels of phonetic talent and psycho-cognitive characteristics. Cross-linguistic studies, such as those by Zokirov and Zokirova (2020), provide valuable insights into the fundamental aspects of phonetics learning by comparing intonation patterns across languages. These findings are important as they contribute to the development of a holistic and effective phonetic learning method that addresses different aspects of language sound production, perception, and analysis.

The findings of this study align with previous research emphasizing the significance of technology in language learning. For instance, Zhang (2020) found that integrating digital tools in phonetics education enhances students' engagement and understanding. Similarly, studies by Tyler (2021) and Nguyen et al. (2021) support the notion that tailored instructional methods considering individual learner differences can significantly improve phonetic learning outcomes. Moreover, the importance of aligning instructional methods with learners' perceptions, as discussed by Nguyen et al. (2021), echoes the findings of this study on the necessity of understanding students' attitudes and expectations.

While the positive impact of technological tools is well-supported, it is essential to consider that not all students may have equal access to these technologies, potentially limiting

the effectiveness of such methods for some learners. Additionally, the individual differences highlighted in the studies could be influenced by external factors such as prior language learning experiences or socio-cultural background, which were not extensively examined in this review. These factors might also play a significant role in phonetic learning and should be considered when interpreting the findings.

This study has several limitations. Firstly, the selection criteria limited the review to English-language studies, potentially excluding valuable research published in other languages. Secondly, the reliance on specific keywords may have omitted relevant studies that did not explicitly use these terms. Lastly, the focus on studies published between 2019 and 2024 might have overlooked earlier foundational research that could provide additional insights into phonetics learning.

Future research should aim to include studies published in multiple languages to provide a more comprehensive understanding of phonetics learning across different linguistic contexts. Additionally, exploring the impact of socio-cultural factors and prior language learning experiences on phonetic learning can offer deeper insights into individual differences. Longitudinal studies examining the long-term effects of technological tools on phonetics education would also be valuable in assessing the sustained impact of these methods. Finally, expanding the review to include research beyond the 2019-2024 timeframe could uncover important historical trends and developments in phonetics learning.

In conclusion, this study highlights the importance of an integrated approach to phonetic education, combining technological advancements, understanding individual differences, and leveraging cross-linguistic insights. By addressing these diverse aspects, educators can develop more effective and accessible phonetic learning methods, ultimately improving students' understanding and practical abilities in this critical area of language study.

CONCLUSION

The systematic literature review on emerging trends in phonetics research from 2019 to 2024 provides a thorough synthesis of recent advancements and ongoing challenges in phonetic education. Key findings highlight the positive impact of technological tools, such as computer-assisted learning systems, which offer interactive and effective pronunciation training. The study also underscores the significance of innovative pedagogical approaches like Communicative Pronunciation Teaching (CPT), which effectively blend explicit phonetic instruction with practical, meaning-focused activities. Additionally, the review identifies a critical gap in the exploration of the long-term impacts of phonetic training and the role of individual learner differences in phonetic acquisition.

The novelty of this research lies in its systematic synthesis of current trends and its focus on practical applications of phonetic research in diverse educational settings. By addressing the multifaceted nature of phonetics learning, the study emphasizes the need for an integrated approach that combines theoretical knowledge with practical skills, leveraging technological advancements and personalized learning strategies. This approach is essential for improving phonetic education and thereby enhancing language education outcomes on a broader scale. Future research should aim to explore the long-term effects of phonetic training and investigate personalized teaching approaches to further advance this crucial field of study.

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