

The Impact of Phonological Awareness Training on Reading Ability in Lower Primary Students

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Abstract. Phonological awareness, also referred to as phonemic awareness, means that children are able to identify and manipulate the sound structure of words, which is the most reliable factor predicting the effectiveness of young children's early reading learning. Because it is important to teach literacy, Chinese character recognition, and form consciousness during the primary school lower grades, the article summarizes the impact of phonological awareness teaching on students' reading, and attempts to discover this through a literature overview and a comprehensive case study. According to the literature review part, the relationship between phonological awareness and acquisition of reading ability has been confirmed to be close; among them, training phoneme skills like separation and synthesis is especially helpful for the decoding ability and reading smoothness of students. It can be seen through the cases that students had experienced remarkable improvements after the intervention of phonological awareness training in decoding skills or reading fluency. This paper argues that the earliest stage of teaching children to read and write is Phonological awareness. The author proposes suggestions based on this article that teachers may give systematic phonological awareness training and teaching activities for students in normal lessons to help children learn to read better. This research can be extended to subject field in future investigations of phonological awareness interventions on the reading abilities of children.

Keywords: Phonological Awareness, Reading Ability, Early Childhood Education, Literacy Intervention

1. Introduction

It is generally believed that reading ability is the most fundamental language ability, the basis for academic performance in all subjects, and one of the abilities for continuous learning. In the early stage of school education, the main influencing factor for the development of reading ability is a variety of cognitive abilities represented by phonological awareness. Phonological awareness is the ability to clearly recognize the sound units (syllables, onset-rime, phonemes) contained in spoken language and control them, which directly affects an individual's reading ability. Relevant studies have shown that phonological awareness is one of the most important predictive indicators affecting word decoding. Currently, most of the evidence comes from languages where the mother tongue is based on alphabetic spelling (e.g., English).

In recent decades, there have been a large number of studies in this field. A research team led by Associate Professor Xie published a study in *Acta Psychologica Sinica* in 2023 [1], which examined the impact of phonological awareness and morphological awareness on students' reading comprehension. Through a longitudinal study, it was found that the mediating effect of phonological awareness indirectly affects reading comprehension by influencing reading fluency.

The National Reading Panel (NRP) [2] in the United States concluded that teaching phonological awareness can improve children's word recognition ability, reading comprehension ability, and spelling ability, while also laying a good foundation for learning phonics.

McCarthy [3] pointed out in an article in the *Cochrane Review* that it can enhance the ability of students with weak English reading skills to pronounce words accurately, read fluently, and master certain comprehension skills.

This study adopts a combination of literature review and case analysis to explore the impact of phonological awareness training on the reading ability of lower-grade primary school students, as well as the current theoretical basis, empirical evidence, and application methods. The value of this study lies in integrating existing relevant knowledge and providing evidence-based ideas for educators; by summarizing relevant domestic and foreign studies and citing practical examples, it aims to provide a reference for the effective implementation of early reading teaching strategies, thereby reducing the occurrence of reading difficulties in young children.

2. Literature review

2.1. The concept of phonological awareness

Phonological awareness is not a single skill but a continuous developmental process that progresses from coarser sound units to finer ones. Specifically, phonological awareness involves the ability to distinguish speech sounds, including identifying rhymes in words and texts, counting syllables, and distinguishing phonemes—the smallest units of speech sounds (e.g., understanding that "cat" is composed of three phonemes: /k/, /æ/, and /t/). As commonly described, it is a "from large to small" developmental process and a criterion for judging whether a child is ready for reading.

Unlike language skills related to speaking and listening, phonological awareness is a metalinguistic skill that requires students to "step back" and think about language itself rather than focusing solely on the communicative function of language. At the same time, it distinguishes between spoken language (which children can acquire on their own) and written language (which requires teaching children how to convert sounds into letters), making it a crucial skill for young students.

2.2. The connection between phonological awareness and reading

Phonological awareness refers to the ability to manipulate and apply linguistic phonological information in the processing of spoken and written language, and it is closely related to reading ability. A large number of studies have shown that phonological awareness is closely associated with reading accuracy and fluency. In alphabetic writing systems, phonological awareness is regarded as an important predictive factor for reading comprehension. For example, Ziegler et al. [4] assessed the reading ability of participants with backgrounds in five languages (Finnish, Hungarian, Dutch, Portuguese, and French) and found that phonological awareness had a predictive effect on word reading fluency for users of all five languages.

Song et al. [5] conducted a meta-analysis on Chinese and found that the results of 35 Chinese studies showed a moderate correlation between phonological awareness and reading accuracy, as well as between phonological awareness and reading fluency. This correlation does not change with age or language.

Improving phonological awareness helps children establish a systematic correspondence between graphemes and phonemes, promotes the conversion of visual input of words into phonological representations, accelerates the processing speed of words and sentences, and facilitates the development of reading comprehension ability. For example, familiarity with grapheme-phoneme conversion in English reading can reduce the load on phonological working memory during reading; although Chinese characters are logographic, phonological awareness can connect graphemes and phonemes in Chinese characters, facilitate word segmentation, and further promote sentence processing, thus playing an important role in improving comprehension and reading speed. The unique phonetic component (shengmu, or phonetic radical) of Chinese characters can provide certain phonological cues for the entire character from the perspectives of syllables, alliteration, and assonance.

Different components of phonological awareness have different impacts on reading ability: In English, after children enter school and receive reading education, phonemic awareness becomes the most important predictive factor for the development of English reading; in Chinese, syllabic awareness is a key predictive factor for the development of reading ability in Chinese children. In addition, onset-rime awareness and tonal awareness are also important predictive factors for the development of Chinese reading. For example, a longitudinal study on Cantonese-speaking children found that children's ability to recognize rhymes and tones at the age of 3 could effectively predict their word recognition ability at the age of 5.

2.3. Theoretical research, intervention methods, and results in this field in existing domestic and international literature

2.3.1. Theoretical research

According to Frith's [6] view, children's reading ability is divided into three stages: the logographic stage, the alphabetic stage, and the orthographic stage. Only by mastering a keen awareness of phonological details can children transition from the logographic stage to the alphabetic stage. Failure to establish grapheme-phoneme correspondence rules may lead to severe delays in children's reading learning ability [7].

The DIER hierarchical hypothesis established by Kim [8] suggests that lower-level reading cognitive skills can predict higher-level reading cognitive skills, while higher-level reading cognitive skills affect reading comprehension. Among these abilities, word reading fluency is a higher-level ability and a key factor in reading comprehension; therefore, from the perspective of automaticity theory, DIER holds that word reading fluency → reading comprehension, and word reading fluency can be mediated by silent sentence reading fluency. The possession of abilities such as phonological awareness in early childhood allows children to progress from the word level to the sentence level, and on this basis, gradually reach the text level.

2.3.2. Intervention methods

There are multiple specific implementation pathways for phonological awareness intervention, with each pathway having distinct focuses on core training objectives and methods. Among these, pure

phonological awareness intervention serves as the foundational form, primarily centered around three levels—syllables, onset-rime, and phonemes. It encompasses training in key abilities such as identification, blending, segmentation, deletion, and substitution, aiming to help learners establish basic perception and manipulation skills for phonological units.

Building on pure phonological training, some intervention programs integrate other relevant knowledge to enhance effectiveness, leading to more comprehensive intervention approaches. For instance, in intervention programs that combine phonological awareness with letter knowledge, the "Play-on" training program developed by Danon-Boileau and Barbi [9] is a typical example. From the perspective of pronunciation comparison, this program combines consonant phonemes with vowel phonemes, and indirectly strengthens children's phonological awareness by guiding them to identify the different positions of syllables and phonemes. In contrast, grapheme-phoneme correspondence phonological intervention training focuses on the "Five-Step Training Method" pioneered by American psychologist Blachman [10]. Its goal not only involves helping learners master the correspondence between graphemes and phonemes but also achieving improved rapid reading ability through practicing phoneme analysis and manipulation, as well as developing coding skills.

Beyond integrating letter or symbol knowledge, some intervention programs emphasize the combination of phonological training with language application scenarios, particularly highlighting the linkage with written language. The "Adaptive Interactive Writing Intervention" proposed by American scholar Craig et al. [11] embodies this approach. This intervention model effectively integrates oral language activities with writing activities, allowing learners to consolidate phonological perception in the process of actual language output and making phonological awareness training more aligned with real-life language use scenarios.

Additionally, feedback mechanisms and systematic training frameworks are widely applied in phonological awareness intervention, forming two types of distinctive intervention pathways. On one hand, programs that utilize feedback to improve children's phonological awareness are represented by the ADD program designed by Charles Lindamood and Patricia Lindamood [12]. This program helps students distinguish and classify sounds through feedback across three dimensions—visual, auditory, and oral movement—thereby enhancing their phonological perception ability. On the other hand, comprehensive training programs are typified by the RAVE-O program [13], which is based on the "Double Deficit Hypothesis" theory. Specifically developed for children with reading difficulties, this program focuses on training three core abilities: phonological awareness, rapid naming, and orthographic awareness. It is divided into five training levels according to difficulty gradients, namely phonological training, orthographic rule training, recognition fluency training, sound sliding training, and dice game training, forming a progressive and systematic intervention system.

2.3.3. Results in this field in existing domestic and international literature

Liu Hanlong and Zhao Jing [14] found that enhancing the phonological awareness of young Chinese children (lower-grade primary school students) can improve their sound-symbol mapping ability, promote the learning of Chinese characters, and thus optimize the process of Chinese character decoding and fluent reading. Liu et al. [15] investigated the predictive factors of Chinese character reading accuracy and fluency in children from grades 1 to 6, and the results showed that the phonological awareness of lower-grade children can well predict the development of reading fluency.

Other studies have shown that different research has obtained different results. Some studies found that phonological awareness training can directly improve the reading comprehension of German-speaking children with reading difficulties [16], and visually based reading training can also benefit them; phonologically based reading training can directly and specifically improve decoding ability, but not reading comprehension. In the long run, trainees in different training groups have made certain improvements in reading comprehension and decoding ability, that is, all groups have achieved the same degree of improvement in reading comprehension and decoding ability. However, experiments found that for first-grade students with reading delays in randomized controlled trials, phonological awareness training had little impact on their reading and phonological awareness measurements. Other studies found that children with language disorders who received phonological awareness training made significantly greater progress in phonological awareness ability and reading development than those who received other types of language training, and it also promoted the improvement of children's speech clarity.

3. Case study

3.1. Domestic real-life case: an AI-powered reading intervention program for rural children

3.1.1. Specific source

According to reports from media outlets such as Jiemian News, in 2024, a program named "Benefits of Reading" (Kaijuan Youyi) was implemented at the left-behind children's center in Tongyu County, Jilin Province. Co-launched by a technology company and education experts, this program aims to enhance the phonological awareness and reading skills of children with reading difficulties through artificial intelligence (AI) technology.

3.1.2. Case details and findings

This project utilizes tablet computers to provide children with personalized Artificial Intelligence (AI)-powered training courses. These courses are primarily designed based on the characteristics of the Chinese language, with a core focus on phonological awareness training. Specifically, the training includes phoneme discrimination exercises for distinguishing initial consonants, final vowels, and tones (e.g., differentiating between "bā (巴)" and "pā (趴)"); syllable segmentation practices to help children break down complete syllables into smaller phonetic units; and syllable blending exercises to train children to recombine segmented phonetic units into complete syllables. Meanwhile, the AI system can collect children's pronunciation data in real time and provide timely error-correction feedback for mispronunciations, helping children quickly adjust their pronunciation methods.

After one semester of intervention practice, the study observed that children made significant progress in Chinese language learning. Specifically, there was a notable improvement in both their Chinese character recognition accuracy and reading fluency. Additionally, they became more proficient in using the "form-sound" correspondence rule (i.e., analyzing the pronunciation rules of Chinese characters through their structural forms) to interpret unfamiliar Chinese characters. This indicates that phonological awareness training has helped children establish clearer form-sound associations of Chinese characters, laying a foundation for independent reading.

At the same time, children reported that the gamified training design in the courses (such as phonetic interaction levels and instant reward mechanisms) made the originally tedious Pinyin

learning more engaging. This effectively stimulated their enthusiasm and initiative in learning Chinese, reducing their resistance to Pinyin learning. These practical results also prove that phonological awareness training is of great significance for Chinese-speaking children's language learning. Even among the group of left-behind children in rural areas with relatively limited resources, their Chinese reading ability can be effectively improved after receiving systematic and personalized intervention training. This provides a feasible and practical path for children's language education in areas with insufficient educational resources.

3.2. International classic case: the fast forward program and brain remodeling

3.2.1. Specific source

This case originates from the research conducted by American neuroscientist Michael Merzenich [17] and his team, which led to the development of the well-known cognitive training program Fast ForWord. Relevant research and cases have been widely reported and included in scientific works such as *Change Your Brain, Change Your Life* [18].

3.2.2. Case details and findings

The core principle of the Fast ForWord program lies in the fact that the fundamental issue for many children with reading difficulties is that their brains cannot effectively process sound variations in speech. The program conducts intensive auditory processing and phonological awareness training in the form of computer games. During the auditory training, the system teaches children to distinguish between different consonant parts in words (e.g., "ba" or "da"). These sounds are presented in an especially slow and exaggerated manner to ensure children can clearly identify them, and then gradually returned to normal speech speed.

Through comparative analysis of brain scans and standardized reading ability test data before and after controlled experiments, researchers have drawn groundbreaking conclusions. At the physiological level of the brain, functional Magnetic Resonance Imaging (fMRI) tests conducted on children with reading difficulties after training revealed that the previously less active speech processing brain regions (mainly located in the left hemisphere) in these children were well activated, and their speech processing patterns became more similar to those of normal readers. This change directly proves the positive regulatory effect of the training on the brain's functional regions.

At the level of reading ability, in terms of behavioral performance, children who received the training made significant progress in the three core reading abilities: phonological awareness, decoding ability, and reading comprehension. According to some research data, after only a few weeks of training, the reading level of some children improved by 1-2 grade levels, which fully demonstrates the high efficiency of this training program in improving actual reading performance.

These research findings collectively indicate that phonological awareness training can not only directly improve reading behavior but also reshape the brain's neural circuits. This dual improvement from the "neural basis" to "behavioral performance" means that the training can fundamentally solve children's reading difficulties and provide key empirical support for understanding the role of brain neural plasticity in educational interventions.

4. Findings and discussion

4.1. Findings

These cases with different cultures and methods collectively reveal a core fact: the development of reading ability is fundamentally based on the brain's ability to process phonological details. On the basis of targeted cultivation of children's phonological awareness, their brain functions and neural connections can be reconstructed, thereby fundamentally improving their reading ability. More importantly, whether using AI to identify Chinese initial consonants and final vowels or using computer programs to identify English speech signals, the core is to conduct auditory training on the auditory processing system to enable the brain to perceive, analyze, and manipulate speech sounds. Therefore, the direct effect of such training on preschool children is to improve their decoding ability from text symbols to speech sounds; in-depth research also found that it can increase the activation and optimization of brain networks responsible for reading (such as the left hemisphere speech processing area responsible for reading), that is, such training not only changes human behavior but also changes the basic physiological operation mechanism of the brain.

In addition, both cases show that implementing personalized and gamified training for different children stimulates their learning interest and initiative, resulting in the most effective intervention effect. Therefore, these cases collectively confirm that phonological awareness is a bridge connecting "text form" and "text meaning"; strengthening this communication channel is a good way to improve reading decoding and reading ability.

4.2. Discussion

A comprehensive analysis of these cases leads to the following conclusions:

First, speech and auditory awareness training is necessary, and the earlier the intervention, the better the effect. Both cases take lower-grade primary school students as the research objects. This selection indicates that early phonological intervention can accurately grasp the critical period for the development of reading ability. During the stage when children's cognitive and language systems are rapidly developing, it lays a core foundation for the subsequent development of reading skills and effectively reduces the risk of reading disabilities in the future.

Second, interest is a key factor in improving training effectiveness. The gamified training method adopted in the domestic case and the animation feedback method used in the foreign case essentially activate children's internal learning motivation through a "gamified form." This is in line with the learning characteristics of young children, who are "experience- and fun-oriented." It can not only reduce learning resistance and extend concentration time but also strengthen a sense of accomplishment through immediate feedback, forming a positive cycle of "training → obtaining positive feedback → increasing interest → more active training," and ultimately significantly optimizing the training effect.

Third, personalized intervention is the future trend of educational intervention. The practical approach presented in the Jilin case—using technology to achieve accurate assessment and formulating customized plans based on the actual situation of the target group—breaks the limitations of the traditional "one-size-fits-all" group training model. It can provide more targeted intervention for children's individual differences in phonological perception ability, learning rhythm, and weak links. For example, it adds basic auditory training modules for children with weak phonological discrimination ability and designs special rhythm exercises for children with insufficient rhythm perception, thereby maximizing intervention efficiency.

Fourth, the effect of phonological awareness training is extensible. Its value is not limited to improving students' reading levels but can also produce multi-dimensional positive collateral effects. On the one hand, the improvement of reading ability reduces children's sense of frustration in learning and further enhances their self-confidence; on the other hand, it can further stimulate their interest in learning during the training process. These positive impacts will have long-term benefits for children's future learning and development.

5. Conclusion

To understand the impact of phonological awareness training on the reading ability of lower-grade primary school students, this study conducted a review of relevant literature and analyzed two cases. It was found that clear and systematic training of children's skills, such as phoneme segmentation and phoneme blending, can improve their decoding ability and reading fluency; at the same time, such intervention is also effective for students with normal development levels and students at risk of reading difficulties. This confirms that the initial hypothesis—that phonological awareness is a malleable and teachable skill—is correct, and it can indeed promote the development of students' reading ability.

This article combines international theories with typical cases in the Chinese context, thereby expanding the existing theories in China; it also extends previous theories by providing a specific example that "well-designed interventions can still produce positive effects even under the constraints of regular classroom or group teaching scenarios."

Practically, it provides frontline teachers and curriculum developers with a set of specific phonological awareness teaching programs applicable to the early reading and writing education stage, which plays an important role in preventing reading difficulties and cultivating students' advanced reading and writing skills.

This study has certain limitations. For example, the case studies have small sample sizes and short observation periods for intervention measures, which limit the promotion and application of the conclusions. Future research can introduce control groups for comparison. Future studies can consider conducting large-scale longitudinal studies to explore how initial phonological training affects long-term reading comprehension ability; they can also explore ways to combine digital tools or games with phonological awareness training to make phonological awareness training more attractive and easier to promote.

In general, this article is a new attempt to apply phonological awareness training to language classrooms and an exploration of "evidence-based teaching." Although the research object is lower-grade primary school students, it can help more children become articulate, proficient in reading aloud, skilled, and confident readers.

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