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Mapping the phonological processes of 4, 5, and 6 years old children in PAUD Tasikmalaya

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ABSTRACT

Phonological ability reflects the perceptual and cognitive mechanisms required for children to learn and produce speech. This study aims to map phonological processes in early childhood at PAUD institutions in Tasikmalaya. Using a qualitative descriptive approach, data were collected from 315 children aged 4–6 years (77 aged 4, 148 aged 5, and 90 aged 6) across five schools: RA Baiturrahman, TK Negeri Pembina, TK Cangkurileung Kartika IX-10, TK IT Ihya As-Sunah, and Joykids. Speech samples in Indonesian were obtained through recordings of both structured and conversational speech. Data validity was ensured through expert judgment, and analysis followed the stages of data reduction, display, and verification. Results show that assimilation was the most dominant phonological process for both vowels and consonants across all ages. For vowels, assimilation declined with age (9 cases at age 4, 7 at age 5, and 3 at age 6), while addition (4 → 2 → 2) and substitution (3 → 0 → 1) were less frequent. Consonant assimilation was more prevalent (62 → 71 → 27), with gliding substitution (13 → 5 → 0) and general substitution (4 → 2 → 0) steadily decreasing. Sound addition appeared only at age 6 (3 cases). These findings indicate that vowel mastery stabilizes earlier, while consonant mastery involves more complex developmental processes. The study provides baseline data for identifying phonological difficulties early and offers guidance for PAUD teachers to recognize ongoing phonological processes beyond age six as possible signs of language delay.

Introduction

The initial ability that children must master is phonological ability. This ability has a big influence on children's language skills (Anthony, JL & Francis DJ, (2005). The development of basic skills including the development of language skills can be done starting from the PAUD (Early Childhood Education) level. Through language development, children can learn to know and control themselves. Knowledge of pragmatic, semantic, syntactic, and phonological systems can be developed by children unconsciously when learning to speak at home or school (Tompkins, 1991:8) through Zubaidah, 2004:461). Therefore, Mapping children's phonological abilities in PAUD is very important to do as preparation for children to develop other abilities.

Based on the results of initial observations, there is one child in Cipakat Kindergarten, a child with the initials ES who is 5 years old, who is already able to pronounce the consonant sounds /c/ /d/ /k/. The

consonant /r/ when in the middle of a word can be pronounced perfectly, but not perfectly when the position of /r/ is at the end. For example, in the song Cicak-cicak di Dinding, as follows:
Actual Lyrics:
Cicak-cicak di dinding.
Diam-diam merayap.
Datang seekor nyamuk.
Hap lalu ditangkap.

Child Sayings:
Cicak-cicak dingdingding.
Diam diam merayap
Datang seekoy nyamuk.
Hap lalu ditangkap.

Phonetic Transcription:
[ci.cak-cicak diŋ.diŋ.diŋ]
[di.am-di.am mə.ra.yap]
[da.taŋ sə.ɛ.koy ña.mU?]
[hap la.lu di.taŋ.kap]

At Baiturrahman Kindergarten, a child with the initials FA who is 5 years 5 months old, is already able to express the acquisition of bilabial consonant sounds /p/ /b/, labiodental /f/, dental /t/ /d/, alveopalatal /ts/ /d/, and velar /k/ /g/. The phoneme /r/ at the end of a word can be pronounced perfectly, but not perfectly when the /r/ is in the middle. Apart from that, in the phonological process of syllable structure, FA reduces the group of the word "Hijau" to [Ijow]. One group of consonants is reduced to just one consonant (Ingram in Fletcher 1979: 135-140). For example, in the song Balonku, FA says the lyrics as follows:
Actual Lyrics:
Balonku ada lima
Rupa-rupa warnanya
Hijau, kuning, kelabu
Merah muda dan biru
Meletus balon hijau, dor!
Hatiku sangat kacau
Balonku tinggal empat
Kupegang erat-erat.

Child Sayings:
Balonku ada lima
Lupa-lupa walnanya
Ijow, kuning, kelabu
Mela muda dan bilu
Meletus balon hijau, dor!
Hatiku sangat kacau
Balonku tinggal empat
Kupegang erat-erat.
Phonetic Transcription:
[ba.lOn.ku a.da li.ma]
[lu.pa -lu.pa wal.na.ña]
[i.jOw ku.nIng kə.la.bu]
[mɛ.la mu.da dan bi.lu]
[mə.lə.tUs ba.lOn hi.jaw, dOr!]
[ha.ti.ku sa.ŋat ka.ca^{w}]
[ba.lOn.ku tiŋ.gal əm.pat]
[ku.pɛ.gaŋ ə.rat-ə.rat]

This research is based on the fundamental understanding that phonological ability is a vital foundation for early childhood language development. Children simplify speech through natural strategies that reflect universal patterns of development (Ingram, 1976). Over time, these processes diminish as their phonological

system matures (Vihman, 2014). Neuroscientific studies further show that infants actively "crack the speech code" by attending to distributional cues in their environment, a process highly influenced by bilingual exposure (Kuhl, 2004). As highlighted by Anthony & Francis (2005), this skill is crucial and serves as the initial capital for children to acquire other skills, even at the PAUD (Early Childhood Education) level. However, despite its importance, a systematic and detailed mapping of how children master this ability is often lacking. Our initial observations revealed significant variations and specific challenges in two different children. A child with the initials ES (5 years old) showed a consistent difficulty pronouncing the consonant /r/ at the end of words, as seen when he said "dingdingding" instead of "dinding" and "nyamuk" instead of "nyamuk." In contrast, a child with the initials FA (5 years and 5 months old) struggled with the /r/ in the middle of a word ("lupa-lupa" instead of "rupa-rupa") and also exhibited another phonological process: syllable reduction, pronouncing "Hijau" as "Ijow." These findings show that phonological problems in PAUD children are diverse and go beyond a single phoneme or isolated case. Ferguson and Farwell (1975) found that children's earliest words frequently emerge from simplified phonetic patterns, which explains why reductions and substitutions, such as [Ijow] for *Hijau*, occur as part of typical phonological development.

Based on these findings, the research problem can be formulated more specifically: "What are the patterns of phonological acquisition in young children, and what are the specific types of phonological errors (including phoneme errors and phonological processes) they most commonly make?" To answer this question, the research has two main objectives. First, we aim to map the phonological abilities of PAUD children comprehensively, identifying which consonant phonemes they have and have not yet mastered. Second, we will identify and analyze the various types of phonological difficulties, focusing not only on specific phonemes like /r/ but also on the position of the phoneme within a word (initial, middle, or final) and other phonological processes like syllable reduction. By analyzing these broader patterns, we can gain a deeper understanding of the complexity of phonological development in early childhood.

The above phenomenon is in line with research conducted by Dardjowidjojo (2019). In Echa (Dardjowidjojo's granddaughter), perhaps also in other Indonesian children, the Afric sounds /tʃ/ and /d3/ were mastered later, around the age of 4;0. The word *jam*, for example, is still pronounced as /*tam*/ or /*dam*/. When "forced" to say it correctly, Echa said, "I can't, Grandma!" The sound /r/ appeared in Echa when she was 4;9 (Dardjowidjojo, 201: 246). While this finding provides valuable insight into the sequence of phonological acquisition in one Indonesian child, it is based on a single case study. Little is known about whether similar developmental patterns occur more broadly in Indonesian children, particularly those growing up in bilingual contexts such as Sundanese–Indonesian in Tasikmalaya. This gap highlights the need for systematic mapping of phonological processes across a larger group of children in order to capture both universal trends and local variations in acquisition.

Age 4 to 6 years is the golden age of child development, including in terms of language. At this age range, language acquisition, especially phonological abilities, is not yet fully perfect. Children still often make substitutions, distortions, or omissions of sounds in their speech, which is a natural part of the phonological development process. Neurological factors, such as the development of the prefrontal cortex, play a major role in spontaneous speech and verbal fluency in children. Delays or deviations in this development, if not mapped properly, can have an impact on other aspects, such as early literacy skills.

Phonological abilities are important foundation for further language acquisition. Children who experience phonological delays may show difficulties in reading and writing skills in elementary school. Therefore, it is important to map the phonological processes that occur naturally in early childhood, to provide appropriate interventions when necessary. Local cultural and language contexts also influence children's phonological development. Tasikmalaya, where the majority of the population uses Sundanese as their mother tongue, offers unique dynamics due to the interaction between local languages and Indonesian in the PAUD educational environment. Children in Tasikmalaya often learn Indonesian as a second language through formal education, thus allowing for unique phonological interference.

Initial observation results show variations in phonological processes in children aged 4–6 years in several PAUDs in Tasikmalaya. For example, 4 years old children still experience sound substitutions /c/, /d/, /k/, and /r/, while 5 years old children show improvements in articulation, although there are still omissions or changes in certain sounds. 6 years old children generally show a more stable phonological system, but some processes of simplification of syllable structures, such as group reduction, are still found.

Mapping the phonological processes that occur at these critical ages is important to obtain a more comprehensive picture of children's phonological development. Thus, the results of this study not only contribute to the development of Indonesian children's language acquisition studies, but also provide practical input for PAUD teachers, parents, and curriculum developers in optimizing early childhood language stimulation.

Method

This study used a descriptive qualitative approach that aims to describe in detail the phonological abilities of early childhood in PAUD Tasikmalaya. This method was chosen because it allows researchers to explore phenomena in depth through verbal and contextual data, not numbers (Creswell, 2014).

The subjects of the study were 315 children aged 4–6 years from five PAUD institutions representing variations in institutions in four sub-districts in Tasikmalaya. Purposive sampling technique was used in selecting institutions and participants based on age criteria and PAUD types (state, private, integrated Islamic, and Christian). The research data are in the form of children's speech in Indonesian, observation results, teacher interviews, and parent questionnaires. Data collection was carried out through direct observation of children's interactions, conversation recordings, and interviews and questionnaires as contextual complements.

The data analysis step began with phonetic transcription to identify the language sounds produced by the child and the phonological processes that occur. This process was complemented by data coding, arrangement in tables and graphs, and descriptive analysis to map patterns of phonological abilities. The analysis was carried out interactively through the process of data reduction, data display, and verification, in accordance with the concept of Miles and Huberman (2014), until data saturation is achieved. The validity of the results was strengthened through triangulation and discussion with a team of experts.

Results and Discussion

Phonological Processes in Children

It is known that the phonological processes in children aged 4-6 years in PAUD Tasikmalaya includes various sound adaptations, both in vowels and consonants. In vowels, the processes that occur include substitution, assimilation, progressive assimilation, vowel assimilation, syllable deletion, sound addition, and inconsistent pronunciation. In consonants, there are substitutions, gliding substitutions, assimilation, progressive assimilation, syllable deletion, simplification, and sound addition. These processes reflect complex developments that support children's language skills.

Table 1. Vowels Distribution in 4, 5, 6 Years Old Children

No	*Phonological Process*	*Age 4 Years*	*Age 5 Years*	*Age 6 Years*
1	Substitution	3	0	1
2	Gliding Substitution	0	0	0
3	Assimilation	9	7	3
4	Progressive Assimilation	1	0	0
5	Regressive Assimilation	0	0	0
6	Vocal Assimilation	1	2	0
7	Deletion of unstressed syllables	1	1	0
8	Simplification	0	0	0
9	Addition of Vocal Sounds	4	2	2

The table above showed that the phonological development of children between the ages of 4 and 6 years showed an increase in complexity in vowel pronunciation. At the age of 4 years, children experienced various phonological processes that showed phonetic changes in vowel pronunciation. The main processes found in this data were substitution 3 (16%), assimilation 9 (48%), progressive assimilation 1 (5%), vowel assimilation 1 (5%), sound addition 4 (21%), and syllable deletion who did not receive sound pressure 1 (5%).

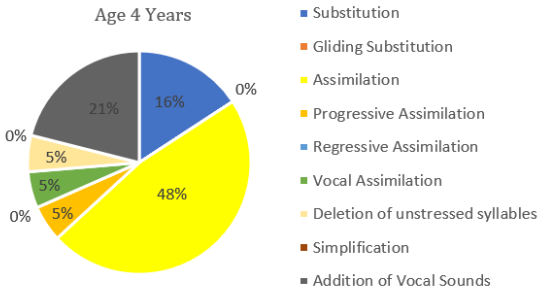

Fig 1. Diagram of Vocal Phonological Process of 4 Years Old

At the age of 5 years, children showed significant development in their articulation abilities, although some phonological processes were still occurring. The most dominant processes were assimilation 7 (58%), vowel assimilation 2 (17%), sound addition 2 (17%), and deletion of unstressed syllables 1 (8%).

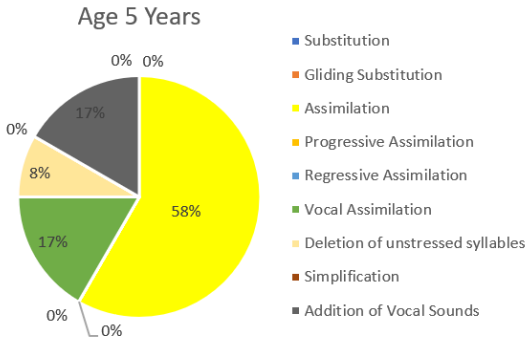

Fig 2. Diagram of Vocal Phonological Process of 5 Years Old

At the age of 6 years, children showed excellent phonological. At the age of 5 years, children showed significant development in their articulation abilities, although some phonological processes were still occurring. The most dominant processes were assimilation 7 (58%), vowel assimilation 2 (17%), sound addition 2 (17%), and deletion of unstressed syllables 1 (8%).

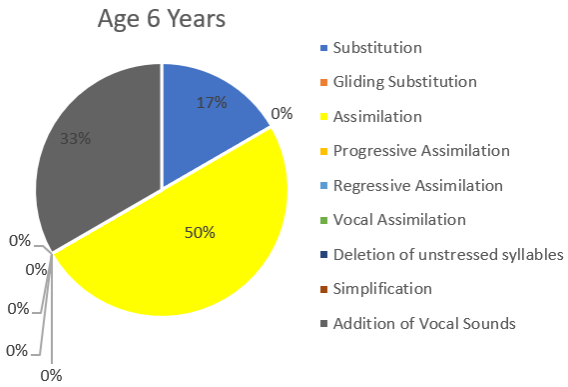

Fig 3. Diagram of Vocal Phonological Process of 6 Year Olds

At the age of 6 years, children showed excellent phonological development, with significant reductions in many phonological processes that are common at younger ages. Some of the phonological processes that occur include: substitution 1 (17%), assimilation 3 (50%), and sound addition 2 (33%). In the phonological process, consonants at the age of 4 years, children experienced various phonological processes that showed phonetic changes in consonant pronunciation. In the table below it can be seen that the main processes found in this data are substitution 4 processes (4%), gliding substitution 13 processes (14%), assimilation 62 processes (68%), progressive assimilation 9 processes (10%), and syllable deletion. Which did not receive sound pressure 3 processes (3%), and simplification 1 (1%). This is part of normal phonological development at the age of 4, children try to master the sounds of language gradually and naturally simplify or replace more complex sounds with easier ones.

In addition to vowel processes, consonant processes also play a crucial role in children's phonological development. While vowels generally stabilize earlier, consonants tend to involve more complex patterns such as assimilation, gliding, and substitution, which can persist across ages. These processes not only reflect the natural strategies children use to simplify speech sounds but also indicate the gradual mastery of more marked and difficult phonemes. Therefore, analyzing consonant processes provides deeper insights into how children progress from less accurate to more stable phonological production. To capture these developmental changes, the present study categorized consonant phonological processes by age groups (4, 5, and 6 years). This categorization makes it possible to observe which processes dominate at earlier stages and which ones diminish as children grow older. The detailed distribution of each phonological process in consonants across the three age groups is presented in Table 2.

Table 2. Table 2 Distribution of Consonants in 4, 5, 6 Years Old Children

No	*Phonological Process*	*Age 4 Years*	*Age 5 Years*	*Age 6 Years*
1	Substitution	4	2	0
2	Gliding Substitution	13	5	0
3	Assimilation	62	71	27
4	Progressive Assimilation	9	3	2
5	Regressive Assimilation	0	1	0
6	Deletion of unstressed syllables	3	1	0
7	Simplification	1	1	0
8	Addition of Sounds	0	0	3

Table 2 shows the distribution of consonant phonological processes among children aged 4, 5, and 6 years. At age 4, the most dominant process was assimilation (62 cases), followed by gliding substitution (13 cases) and substitution (4 cases). Progressive assimilation occurred in 9 cases, while other processes such as deletion of unstressed syllables (3 cases) and simplification (1 case) appeared less frequently. At this stage, no cases of vocal assimilation or addition of vocal sounds were found. At age 5, assimilation became even more frequent (71 cases), while gliding substitution decreased to 5 cases and substitution to 2 cases. Progressive assimilation dropped to 3 cases, regressive assimilation appeared once, and deletion of unstressed syllables occurred only once.

By age 6, the overall frequency of phonological processes declined considerably. Assimilation remained dominant but with a much lower frequency (27 cases), while progressive assimilation was observed in 2 cases. Interestingly, the addition of vocal sounds appeared at this age (3 cases), which had not been observed previously. Other processes such as substitution, gliding substitution, regressive assimilation, deletion of unstressed syllables, and simplification were no longer present. These results indicate that assimilation is the most persistent process across all ages, while other processes gradually diminish, reflecting the developmental progression toward more accurate and stable phonological production.

To complement the tabular data, the distribution of phonological processes is also presented in the form of pie charts for each age group. Figure 4 illustrates the phonological processes observed in 4-year-old children.

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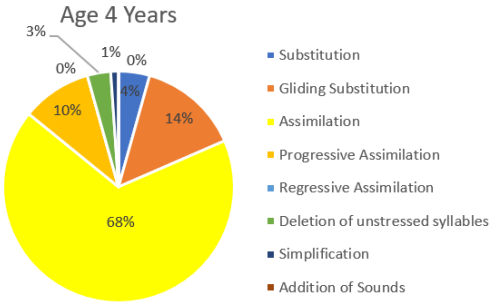

Fig 4. Diagram of the Phonological Process of Consonants at Age 4 Years

At the age of 4 years, children still showed various phonological processes as part of natural development. The most dominant process were assimilation (68%), followed by gliding substitution (14%), progressive assimilation (10%), and general substitution (4%). Other processes such as syllable deletion (3%) and simplification (1%) also still appear. No regressive assimilation, vowel assimilation, or consonant sound addition was found. This reflects that 4-year-old children still use sound simplification strategies.

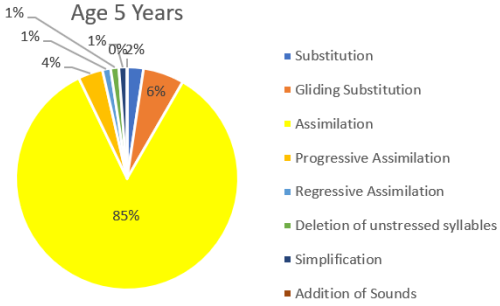

Fig 5. Diagram of the Phonological Process of Consonants at 5 Years

At the age of 5 years, children showed significant development in their articulation skills, although some phonological processes are still occurring. The most dominant processes were assimilation 71 (84%), substitution 2 (2%), gliding substitution 5 (6%), simplification 1 (1%), deletion of unstressed syllables 1 (1%), progressive assimilation 3 (4%), and regressive assimilation 1 (1%). Overall, by age 5, the more complex phonological processes begin to diminish, and children move closer to pronunciation that is closer to the correct language standard.

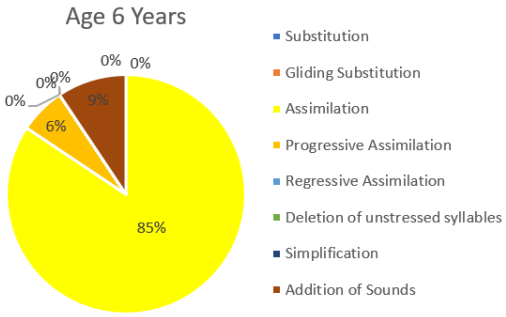

Fig 6. Diagram of the Phonological Process of Consonants at Age 6 Years

At the age of 6 years, the child showed excellent phonological development, with a significant reduction in many of the phonological processes that are common at younger ages. Some of the phonological processes that occurred included: assimilation 27 (85%), sound addition 3 (9%), progressive assimilation 2 (6%), other processes such as substitution, gliding substitution, vowel assimilation, syllable deletion, and simplification were not found at age 6, indicating that the child had mastered a more standard pronunciation and was no longer experiencing significant phonological difficulties. Overall, at the age of 6, the child had reached a more mature level of phonological mastery and was approaching the standard pronunciation of the language, with few phonetic changes still occurring.

The findings indicate that vowel phonological processes in children aged 4–6 develop gradually. At the age of 4, children still frequently experienced substitution, assimilation, vowel addition, and syllable deletion. By the age of 5, these processes had begun to decrease, although assimilation remained the dominant pattern. Six-year-old children demonstrated a relatively stable vowel system, with only a few phonological processes still occurring. This pattern is consistent with Ingram (1979), who stated that vowels tend to be acquired earlier than consonants, leading to fewer simplification processes as children grow older. The persistence of assimilation until the age of 6 also supports Jakobson's (1980) law of *irreversible solidarity*, which posits that complex sounds are acquired last and that simplified forms may persist longer. Moreover, these findings align with Snowling and Hulme (2014), who emphasized that vowel stability in early childhood is linked to early literacy readiness, making this study significant for early reading stimulation.

With regard to consonants, the study revealed that 4-year-old children still relied heavily on simplification strategies, with assimilation as the most dominant process (68%), followed by gliding substitution, general substitution, and syllable deletion. At the age of 5, children's articulation improved, but assimilation remained high (84%). By the age of 6, simplification processes had decreased drastically, indicating a more stable phonological system. The predominance of assimilation supports the Optimality Theory framework (Barlow & Gierut, 1999), which explains that marked sounds, such as liquids (/r/) and affricates, are typically acquired later. The occurrence of gliding (e.g., /r/ → [w]) is consistent with Dardjowidjojo (2018), who observed that /r/ is one of the most challenging sounds for Indonesian children to master. The dominance of substitution and assimilation among 4–5-year-olds also echoes Bentral, Bankson, and Flipsen (2016), who noted that these processes are natural strategies for simplifying complex sounds. However, the persistence of assimilation even at age 6 may indicate bilingual influence (Sundanese–Indonesian), which aligns with Chirlian and Sharpley (1982), who found that regional variation can affect phonological acquisition. Within the framework of Optimality Theory, Fikkert (2007) argued that marked phonemes, such as liquids and affricates, are acquired later, which explains the persistence of assimilation and gliding processes among younger children. Neurological development also underlies this trajectory; the late mastery of /r/ reflects the maturation of motor planning and speech-motor control (McLeod & Bleile, 2004). For the 5 and 6-year-old groups, the persistence of major simplifying processes beyond the established international age range is typically regarded as a marker of delayed phonological development, potentially classifying the child as having a Speech Sound Disorder (SSD) (Preston & Edwards, 2010; Hassink & Wendt, 2010).

Overall, the developmental pattern from ages 4 to 6 shows a reduction in phonological processes that hinder children's speech clarity. This is consistent with Anthony et al. (2011), who highlighted the strong link between phonological development and reading readiness in early schooling. The decline in phonological errors also supports Castles and Coltheart (2003), who argued that phonological awareness is a crucial prerequisite for literacy. Nevertheless, individual variations were observed, particularly among children who primarily use Sundanese at home, indicating the role of bilingual context, as suggested by Ellis (1990) in second language acquisition theory.

The practical implication of these findings is that PAUD teachers need to recognize that processes such as assimilation or gliding are part of normal development. However, if these processes persist beyond the age of 6, they may serve as indicators of phonological disorders (Rhyner, 2009). Therefore, this study provides a basis for developing phonological assessment tools for Indonesian children that are sensitive to bilingual contexts, as well as for designing appropriate language stimulation programs in early childhood education.

Conclusion

This study aimed to map the phonological processes of children aged 4–6 in early childhood education settings in Tasikmalaya. The findings show that vowel acquisition tends to stabilize earlier, while consonant acquisition involves more complex processes such as assimilation, gliding, and substitution, which persist even at the age of 6. These results confirm that phonological development follows both universal patterns and local variations influenced by bilingual contexts (Sundanese–Indonesian). Phonological processes that occured in early childhood in PAUD Tasikmalaya include several phonological processes that occured in vowel sounds in children aged 4-6 years including substitution, assimilation, progressive assimilation, vowel assimilation, syllable deletion, sound addition, and inconsistent pronunciation. In consonant sounds, several phonological processes that occur in children aged 4-6 years are substitution, gliding substitution, assimilation, progressive assimilation, syllable deletion, simplification, and sound addition. This showed that the development of phonological abilities in children aged 4-6 years includes various complex processes, which are very important for their overall language skills. This process showed how children adapt and learn to master language through diverse pronunciations. However, this study has several constraints. First, the data were collected only from five PAUD institutions in Tasikmalaya, which may limit the generalizability of the findings to other regions in Indonesia. Second, the qualitative descriptive approach provides rich descriptions but does not allow for statistical generalization. Third, the study did not include longitudinal tracking of the same children, which would have given a clearer developmental trajectory. Based on these limitations, future research should involve larger and more diverse samples, including children from different bilingual and multilingual contexts, and consider longitudinal designs to track individual developmental changes. Practically, the results highlight the need for PAUD teachers and parents to pay attention to persistent phonological processes beyond age 6 as possible indicators of speech difficulties. The findings may also inform the development of phonological assessment tools tailored to Indonesian children and guide the design of early interventions to support literacy readiness. Ultimately, phonological acquisition is not only a linguistic milestone but also a predictor of literacy readiness, as language development interacts with cognitive and social growth (Hoff, 2013). This study therefore contributes not only to applied linguistics but also to the broader understanding of child language development in Indonesia (Crystal, 2003).

Declarations

Author contribution : Anggia Suci Pratiwi conceived the study design, coordinated data collection, and drafted the manuscript. I Dewa Putu Wijana and Adi Sutrisno provided theoretical and methodological guidance. Meiliana Nurfitriani contributed to data analysis and literature review. All authors reviewed and approved the final manuscript.

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Conflict of interest : The authors declare no conflict of interest.

Ethics Approval : All procedures performed in this study involving human participants were in accordance with institutional ethical standards. Informed consent was obtained from parents or guardians of all child participants.

Additional information : No additional information is available for this paper

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