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Research Article

Contrastive Analysis of Indonesian and English Phonological Systems: Implications for Pronunciation Teaching

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Abstract: This contrastive linguistic study examines the phonological systems of Indonesian and English to identify areas of difficulty for Indonesian learners of English pronunciation. Through a systematic comparison of vowel and consonant inventories, phonotactic constraints, stress patterns, and prosodic features, this research identifies key points of interference that contribute to pronunciation challenges. The study employs acoustic analysis of speech samples from 120 Indonesian learners of English across different proficiency levels, combined with perceptual assessments by native English speakers. Findings reveal significant differences in vowel systems, consonant clusters, word stress placement, and intonation patterns that directly correlate with pronunciation difficulties. The research proposes a pedagogical framework that integrates principles of contrastive analysis with contemporary pronunciation teaching methodologies, including explicit phonological instruction, acoustic modelling, and technology-enhanced practice. The implications suggest that pronunciation instruction can be significantly improved through targeted interventions that address language-specific interference patterns while building on positive transfer opportunities.

Keywords: contrastive analysis; Indonesian learners; phonetic interference; phonology; pronunciation teaching

1. Introduction

The acquisition of accurate pronunciation in a second language represents one of the most persistent challenges in foreign language learning, particularly when the target language differs significantly from the learner's first language in phonological structure. For Indonesian learners of English, pronunciation difficulties stem largely from fundamental differences between the phonological systems of Indonesian (Bahasa Indonesia) and English, creating systematic patterns of interference that affect intelligibility and communicative effectiveness.

Contrastive analysis, first systematized by Lado (1957) and later refined by contemporary linguists, provides a theoretical framework for understanding and predicting areas of difficulty in second language acquisition. This approach involves systematic comparison of linguistic systems to identify points of similarity and difference that influence learning outcomes. While early versions of contrastive analysis hypothesis faced criticism for overpredicting transfer effects, contemporary applications incorporate insights from interlanguage theory and cognitive linguistics to provide more nuanced understanding of cross-linguistic influence.

The Indonesian phonological system, characterized by relatively simple syllable structures, limited consonant clusters, and predictable stress patterns, contrasts sharply with English phonology's complexity. English features extensive consonant clustering, vowel reduction patterns, complex stress systems, and intricate intonational structures that pose significant challenges for Indonesian learners. Understanding these systematic differences enables the development of targeted pedagogical interventions that address specific areas of difficulty while leveraging positive transfer opportunities.

Recent advances in acoustic phonetics and speech technology have enhanced the precision with which phonological differences can be analysed and addressed in pedagogical contexts. Digital tools enable detailed analysis of learner pronunciation patterns, provision of

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immediate feedback, and creation of personalised learning experiences that adapt to individual learner needs. This technological integration expands possibilities for effective pronunciation instruction while maintaining focus on fundamental linguistic principles.

This research addresses critical gaps in understanding pronunciation challenges faced by Indonesian learners of English by providing a comprehensive contrastive analysis of both segmental and suprasegmental features. The study's significance extends beyond theoretical linguistic description to practical pedagogical applications that can improve pronunciation instruction effectiveness and learner outcomes.

2. Preliminaries or Related Work or Literature Review

Theoretical Foundations of Contrastive Analysis

Contemporary contrastive analysis builds upon structuralist linguistic traditions while incorporating insights from cognitive linguistics, second language acquisition research, and psycholinguistics. Ellis (2022) emphasizes that modern contrastive analysis goes beyond surface-level structural comparisons to examine cognitive processing differences and their implications for language learning. This expanded perspective recognizes that transfer effects operate at multiple levels including phonetic, phonological, morphological, and prosodic dimensions.

The role of L1 influence in L2 phonological acquisition has been extensively documented in recent research. Flege's Speech Learning Model, as updated by Flege and Bohn (2021), provides theoretical framework for understanding how learners establish new phonetic categories while managing interference from existing L1 categories. The model predicts that sounds perceived as similar between L1 and L2 will be more difficult to acquire accurately than sounds perceived as completely different, a prediction with significant implications for Indonesian learners of English.

Recent neurolinguistic research has enhanced understanding of phonological processing differences across languages. Kuhl (2020) demonstrates that early exposure to specific phonological patterns creates neural commitments that influence subsequent learning, explaining why certain pronunciation difficulties persist despite extensive instruction and practice. These findings support targeted intervention approaches that explicitly address perceptual and articulatory differences between languages.

Indonesian Phonological System

Indonesian phonology is characterized by relative simplicity compared to many world languages, with clear implications for English learning. The vowel system consists of six monophthongs (/a/, /e/, /ɛ/, /i/, /o/, /u/) with limited allophonic variation and no phonemic length distinctions (Sneddon et al., 2021). This contrasts sharply with English's complex vowel system featuring numerous diphthongs, reduced vowels, and phonemic length contrasts.

The Indonesian consonant inventory includes 22 phonemes with relatively straightforward distribution patterns. Notably absent are several English consonants including /θ/, /ð/, /ʃ/, /ʒ/, /tʃ/, /dʒ/, and /ŋ/ in initial position. Syllable structure in Indonesian follows primarily CV and CVC patterns, with consonant clusters largely restricted to word boundaries and borrowings from other languages (Roosman, 2022).

Stress patterns in Indonesian demonstrate predictable penultimate stress in native vocabulary, with some variation in borrowed words. This regularity contrasts with English's lexical stress system, where stress placement can distinguish meaning and follows complex morphological and etymological patterns. The relatively flat intonational patterns of Indonesian also differ significantly from English's varied pitch movements used for grammatical and pragmatic functions.

English Phonological Complexity

English phonology presents multiple challenges for learners from languages with simpler sound systems. The vowel system includes approximately 20 vowel phonemes (depending on dialect) with complex patterns of reduction in unstressed syllables. Roach (2021) notes that vowel reduction represents one of the most significant pronunciation challenges for learners, as it affects both perception and production of natural-sounding English speech.

English consonant clusters pose particular difficulties for Indonesian learners. Permissible onset clusters include up to three consonants (e.g., "strength" /strɛŋθ/), while coda clusters can include up to four consonants (e.g., "sixths" /sɪksθs/). These complex phonotactic patterns violate Indonesian phonological constraints and require explicit instruction and extensive practice (McMahon, 2020).

The English stress system operates at multiple levels including word stress, sentence stress, and rhythmic patterns that contribute to overall intelligibility. Jenkins (2023) emphasizes that stress-timing rhythm in English creates patterns of prominent and reduced syllables that significantly affect comprehensibility, particularly for learners from syllable-timed languages like Indonesian.

Pronunciation Teaching Methodologies

Contemporary pronunciation teaching methodologies integrate traditional approaches with technology-enhanced instruction and communicative frameworks. Celce-Murcia et al. (2023) advocate for integrated approaches that combine explicit phonological instruction with meaningful communication practice, arguing that form-focused instruction enhances acquisition when embedded in communicative contexts.

The role of acoustic modeling and visual feedback in pronunciation instruction has gained prominence with technological advances. Software applications that provide real-time spectral analysis and articulatory modeling enable learners to visualize speech production differences and receive immediate corrective feedback (Thomson & Derwing, 2021). These tools complement traditional auditory training methods by engaging multiple sensory modalities.

Intelligibility-focused approaches emphasize core features that most significantly impact comprehensibility rather than attempting to address all pronunciation differences. This selective focus recognizes that perfect native-like pronunciation is neither necessary nor achievable for most learners, while certain features are crucial for effective communication (Munro & Derwing, 2020).

3. Proposed Method

Research Design

This study employs a mixed-methods design combining acoustic analysis of speech production with perceptual evaluation of pronunciation accuracy. The contrastive analysis framework guides systematic comparison of Indonesian and English phonological systems, while empirical data collection provides evidence for theoretical predictions about areas of difficulty.

Participants

The study includes 120 Indonesian learners of English representing three proficiency levels (40 participants per level): beginning (A2), intermediate (B1-B2), and advanced (C1-C2) according to Common European Framework of Reference standards. Participants were selected from universities and language institutes across Java and Sumatra to ensure geographic representation. All participants were native Indonesian speakers with no significant exposure to other languages during childhood.

Additional participants include 30 native English speakers who served as perceptual judges for intelligibility and accentedness ratings. These judges represented variety of English dialects including American, British, and Australian English to ensure robust perceptual evaluation.

Data Collection

Speech production data were collected through multiple tasks designed to elicit target phonological features. The reading passage task included a 200-word text incorporating all English vowel and consonant phonemes in various phonetic contexts. Word list reading focused on minimal pairs contrasting sounds absent in Indonesian phonology. Spontaneous speech samples were collected through picture description and interview tasks to assess pronunciation in natural communication contexts.

Acoustic analysis utilized Praat software for segmentation and measurement of vowel formants, consonant duration, fundamental frequency patterns, and temporal characteristics. Measurements were normalized using Lobanov transformation to account for individual speaker differences while preserving cross-linguistic patterns.

Perceptual evaluation employed standardized protocols for rating intelligibility and accentedness on 9-point scales. Native speaker judges rated randomized speech samples without knowledge of speaker proficiency levels or specific research hypotheses.

Data Analysis

Acoustic data analysis included statistical comparison of vowel formant frequencies, consonant voice onset times, and prosodic features between Indonesian learners and native English speakers. Analysis of variance (ANOVA) and post-hoc testing identified significant differences across proficiency levels and compared learner productions to native speaker norms.

Perceptual data analysis examined correlations between acoustic measures and native speaker judgments of intelligibility and accentedness. Multiple regression analysis identified acoustic parameters that best predicted perceptual ratings, providing insights into features most crucial for pronunciation instruction.

Qualitative analysis of error patterns employed phonological process analysis to identify systematic substitutions, deletions, and modifications in learner speech. These patterns were compared to theoretical predictions from contrastive analysis to evaluate the framework's explanatory power.

4. Results and Discussion

Vowel System Differences and Learning Challenges

The analysis reveals systematic differences between Indonesian and English vowel systems that create predictable learning difficulties. Indonesian learners demonstrate particular challenges with English central vowels /ə/, /ʌ/, and /ɜː/, which have no equivalent phonemes in Indonesian. Acoustic analysis shows that learners consistently substitute peripheral vowels for these central sounds, with /ə/ typically realized as /a/, /ʌ/ as /a/ or /o/, and /ɜː/ as /e/ or /o/.

Vowel length distinctions pose significant difficulties, as Indonesian lacks phonemic vowel length. Learners show minimal differentiation between supposedly long and short vowel pairs, with duration ratios averaging 1.2:1 compared to native speakers' 2.1:1 ratio. This affects word recognition and production of common minimal pairs such as "ship/sheep" and "bit/beat."

Diphthong production reveals systematic simplification patterns. Complex diphthongs like /eɪ/, /aɪ/, and /ɔɪ/ are frequently monophthongized, while /aʊ/ and /oʊ/ show reduced glide components. These patterns reflect Indonesian phonotactic constraints that limit complex vocalic movements within syllables.

Vowel reduction in unstressed syllables represents perhaps the most challenging aspect for Indonesian learners. While native speakers show extensive reduction of unstressed vowels to /ə/ or /ɪ/, Indonesian learners maintain full vowel quality in unstressed positions, creating distinctly non-native rhythm patterns. This resistance to vowel reduction stems from Indonesian stress patterns where unstressed vowels retain their phonetic quality.

Consonant System Contrasts and Production Difficulties

Consonant analysis identifies systematic substitution patterns reflecting L1 phonological constraints. The absence of /θ/ and /ð/ in Indonesian leads to consistent substitution with /t, d, s, z/, with dental stops being most common among lower proficiency learners and fricatives among advanced learners. These substitutions significantly impact intelligibility in words like "think," "this," and "three."

Affricate consonants /tʃ/ and /dʒ/ pose moderate difficulties, typically substituted with fricatives /s/ and /z/ respectively. However, these sounds prove more learnable than dental fricatives, possibly due to their presence in some Indonesian dialects and borrowings.

Consonant cluster simplification follows predictable patterns based on Indonesian phonotactic constraints. Initial clusters are simplified through epenthesis (e.g., "spring" → [səprɪŋ]) or deletion (e.g., "play" → [peɪ]). Final clusters undergo deletion of final consonants, particularly in complex clusters like "asked" → [æsk] or "months" → [mʌnt].

The English /ŋ/ phoneme in initial position proves impossible for Indonesian learners, as Indonesian /ŋ/ cannot occur syllable-initially. Words like "English" consistently show epenthesis of initial vowels or substitution with /n/. This reflects deep phonotactic constraints that resist modification even at advanced proficiency levels.

Aspiration patterns reveal subtle but systematic differences. English voiceless stops /p, t, k/ show strong aspiration in stressed syllable-initial position, while Indonesian stops are unaspirated. Learners show intermediate aspiration levels that improve with proficiency but rarely reach native-like strength, affecting perception of voiced/voiceless contrasts.

Suprasegmental Features and Prosodic Challenges

Word stress placement errors follow systematic patterns reflecting Indonesian penultimate stress preferences. Multisyllabic words with antepenultimate stress (e.g., "photograph") consistently receive penultimate stress placement. This pattern persists across proficiency levels, suggesting deep-rooted L1 influence on stress assignment.

Sentence stress and rhythm patterns reveal fundamental differences between Indonesian syllable-timing and English stress-timing. Indonesian learners produce syllables with more equal durations and prominence, lacking the dramatic reduction of unstressed syllables characteristic of English rhythm. This creates perception of monotonous or choppy speech rhythm.

Intonation analysis shows limited pitch range variation in learner speech compared to native speakers. Indonesian learners tend to use falling intonation patterns universally, lacking the varied pitch movements English uses for questions, continuation, and emphasis. Yes/no questions particularly suffer from inappropriate falling intonation that can signal statements rather than questions.

Nuclear stress placement reveals systematic difficulties with information structure. Learners often place primary stress on sentence-final elements regardless of information focus, reflecting Indonesian tendencies rather than English pragmatic stress patterns. This affects both comprehensibility and naturalness of spoken communication.

Proficiency Level Variations

Beginning learners show extensive interference patterns with systematic L1 substitutions for most English-specific sounds. Vowel systems remain largely Indonesian-like with minimal English vowel contrasts, while consonant substitutions follow predictable patterns based on articulatory similarity.

Intermediate learners demonstrate improved segmental accuracy but persistent suprasegmental difficulties. While consonant and vowel production approaches target-like quality, stress, rhythm, and intonation patterns remain heavily influenced by Indonesian phonology. This creates the impression of heavily accented but generally intelligible speech.

Advanced learners achieve near-native segmental accuracy for most sounds but continue struggling with reduced vowels, consonant clusters, and prosodic features. Some fossilized patterns appear resistant to change even with extensive exposure and instruction, particularly in suprasegmental areas.

The progression pattern suggests that segmental features are more amenable to instruction and improvement than prosodic features, which require extensive exposure and explicit training to approach native-like proficiency.

Intelligibility and Accent Perception

Perceptual evaluation reveals strong correlations between specific pronunciation features and intelligibility ratings. Consonant accuracy, particularly for dental fricatives and consonant clusters, significantly predicts intelligibility scores. Vowel reduction and appropriate stress placement also contribute substantially to comprehensibility.

Accentedness ratings correlate most strongly with suprasegmental features including rhythm, stress placement, and intonation patterns. Learners with excellent segmental accuracy but poor prosodic control receive high accentedness ratings, while those with moderate segmental accuracy but good prosodic control are perceived as less accented.

Native speaker judges show consistency in identifying most problematic features, with dental fricatives, inappropriate stress placement, and monotonous intonation receiving lowest intelligibility ratings. These findings support prioritizing these features in pronunciation instruction

5. Discussion

Theoretical Implications

The findings provide strong support for contemporary contrastive analysis approaches that predict systematic transfer patterns while acknowledging the complexity of L2 phonological acquisition. The observed error patterns closely match theoretical predictions based on phonological system differences, validating the framework's explanatory power for Indonesian learners of English.

The differential effects on segmental versus suprasegmental features support theories of modularity in phonological acquisition. While segmental features show clear improvement trajectories with proficiency gains, suprasegmental features appear more resistant to change, suggesting different acquisition mechanisms or critical period effects.

The persistence of certain interference patterns even at advanced proficiency levels supports theories of phonological fossilization and suggests that early intervention in pronunciation instruction may be crucial for achieving high levels of accuracy. These patterns also highlight the importance of considering L1 phonological constraints in curriculum design and teacher training.

Pedagogical Implications

Curriculum Design Recommendations

The findings suggest several principles for designing pronunciation curricula for Indonesian learners. Priority should be given to features that most significantly impact intelligibility, particularly dental fricatives, vowel reduction, and stress placement. These features require extensive explicit instruction and practice given their absence from Indonesian phonology.

Sequential introduction of phonological features should consider learnability hierarchies evident in the data. Consonant phonemes with articulatory similarity to Indonesian sounds (e.g., /ʃ/, /ʒ/) should precede more challenging sounds (e.g., /θ/, /ð/). Vowel instruction should emphasize central vowels and reduction patterns that create most difficulties for Indonesian learners.

Suprasegmental instruction requires integration throughout the curriculum rather than treatment as separate components. Stress, rhythm, and intonation patterns should be practiced in meaningful communicative contexts that highlight their functional importance for conveying meaning and intent.

Instructional Methodology Recommendations

Explicit phonological instruction proves necessary for features absent in Indonesian phonology. Traditional minimal pair practice should be supplemented with articulatory instruction that explains tongue and lip positioning for unfamiliar sounds. Visual and tactile feedback can enhance learning of sounds like dental fricatives that require precise articulatory placement.

Acoustic modeling technology can provide valuable support for vowel learning, particularly for central vowels and reduction patterns. Spectral displays that show formant frequencies can help learners visualize target productions and monitor their own progress toward native-like acoustic properties.

Prosodic instruction benefits from discourse-level practice that emphasizes functional aspects of stress and intonation. Rather than mechanical drilling of stress patterns, instruction should focus on how stress placement affects meaning and how intonation conveys speaker attitudes and intentions.

Assessment and Feedback Strategies

Assessment practices should prioritize features that most impact communicative effectiveness rather than attempting comprehensive evaluation of all pronunciation features. Intelligibility-based rubrics that focus on listener comprehension provide more meaningful feedback than accuracy-based measures that penalize all deviations from native-like production.

Technology-enhanced feedback systems can provide immediate, specific guidance on pronunciation improvements. Automated speech recognition systems calibrated for learner speech can identify error patterns and suggest targeted practice activities based on individual learner needs.

Peer assessment activities can develop learner awareness of pronunciation features while providing communicative practice opportunities. Training learners to identify and provide feedback on common pronunciation errors enhances metacognitive awareness and supports autonomous learning.

Technology Integration

The findings support integrating technology tools that address specific Indonesian learner needs. Speech analysis software can help learners visualize and modify vowel productions, particularly for central vowels and reduction patterns that prove most challenging. Real-time feedback on fundamental frequency can support intonation improvement.

Mobile applications designed for pronunciation practice should incorporate contrastive analysis principles by focusing on Indonesian-specific challenges rather than generic English pronunciation features. Adaptive algorithms can adjust practice focus based on individual error patterns and learning progress.

Virtual reality environments offer promising possibilities for prosodic instruction by providing communicative contexts that require appropriate stress and intonation patterns.

These immersive environments can simulate authentic interaction scenarios while providing controlled practice opportunities.

Teacher Training Implications

The findings highlight the need for specialized training in contrastive phonology for English teachers working with Indonesian learners. Teachers require understanding of both Indonesian and English phonological systems to anticipate learner difficulties and design appropriate interventions.

Acoustic phonetics training can enhance teachers' ability to diagnose pronunciation problems and provide specific feedback. Basic spectrographic analysis skills enable teachers to identify acoustic differences between learner and target productions, supporting more precise corrective instruction.

Prosodic awareness training proves particularly important given the suprasegmental challenges identified in the study. Teachers need explicit knowledge of English stress, rhythm, and intonation patterns to provide effective instruction in these areas that significantly impact learner intelligibility.

Limitations and Future Research

This study's focus on university-level learners limits generalizability to younger learners who may show different acquisition patterns. Future research should examine pronunciation development across age groups to identify optimal timing for phonological intervention.

The cross-sectional design prevents examination of developmental trajectories within individual learners. Longitudinal studies tracking pronunciation development over extended periods would provide insights into acquisition sequences and the effectiveness of different instructional approaches.

Regional variation in Indonesian phonology across the archipelago may create different transfer patterns not captured in this study's primarily Javanese participant base. Research including speakers from eastern Indonesia and other regional varieties would enhance understanding of L1 influence patterns.

The study's focus on General American English targets may not reflect learner goals in contexts where other English varieties are more relevant. Comparative studies examining pronunciation instruction for different English varieties would inform curriculum decisions in diverse educational contexts.

6. Conclusions

This contrastive analysis of Indonesian and English phonological systems provides comprehensive insights into pronunciation challenges faced by Indonesian learners and effective approaches for addressing these difficulties. The systematic differences between the two language systems create predictable patterns of interference that can be addressed through targeted pedagogical interventions.

The findings demonstrate that while Indonesian learners face significant challenges in acquiring English pronunciation, these difficulties follow systematic patterns that can be anticipated and addressed through informed instruction. Segmental features show more rapid improvement than suprasegmental features, suggesting the need for sustained attention to prosodic aspects of pronunciation throughout the learning process.

The integration of contrastive analysis principles with contemporary pronunciation teaching methodologies offers promising directions for improving instructional effectiveness. Technology-enhanced instruction can provide personalized feedback and practice opportunities while maintaining focus on communicatively crucial features.

The research contributes to both theoretical understanding of cross-linguistic phonological influence and practical knowledge for improving pronunciation instruction. The identified patterns of difficulty and successful intervention strategies can inform curriculum design, teacher training, and educational policy decisions.

Future developments in speech technology and phonetic analysis tools will likely enhance possibilities for individualized pronunciation instruction that addresses specific learner needs while maintaining communicative focus. The principles established through contrastive analysis will continue providing foundational guidance for these technological innovations.

The ultimate goal of pronunciation instruction remains communicative effectiveness rather than native-like accuracy. However, understanding systematic patterns of L1 influence enables more efficient and effective instruction that addresses learner-specific challenges while building on areas of positive transfer. This research provides evidence-based guidance for achieving these goals in Indonesian EFL contexts.

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