
The orthography of implosive consonants in languages of East Nusa Tenggara: Pedagogical implications

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ABSTRACT

Orthography development for the languages of East Nusa Tenggara has been undertaken by various institutions and researchers, resulting in multiple conventions for representing the same phonological features. However, systematic evaluation of these variations remains limited. This study examines how implosive consonants—bilabial /b/, alveolar /d/, palatal /ɟ/, and velar /ɡ/—are represented in existing orthographies and discusses the pedagogical implications of these representations. A comparative qualitative design was employed through documentary analysis and orthography testing. Documentary data were collected from grammars, linguistic publications, and community literacy materials representing eight languages. Orthography testing involved 20 elementary school students and 10 teachers from Hawu and Dela communities. Participants completed oral reading tasks followed by group discussions. The findings reveal considerable variation in the representation of implosive consonants across languages and institutions, including both underrepresentation and overrepresentation of phonemes. These inconsistencies may reduce orthographic transparency and create additional challenges for beginning readers, particularly in multilingual educational contexts. The study highlights the importance of consistent phoneme–grapheme correspondences and encourages collaboration among researchers, institutions, and language communities in developing more transparent orthographic systems for the languages of East Nusa Tenggara.

Keywords: Orthography development, implosive consonants, Multilingual literacy, East Nusa Tenggara

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INTRODUCTION

Orthography development is a crucial step in the documentation, revitalization, and maintenance of regional languages. A well-designed orthography enables speakers to represent the sound system of their language accurately and facilitates the production of educational materials that support literacy development. However, orthography development for many minority languages is often undertaken by different institutions and researchers working independently, which may result in multiple orthographic conventions for the same language. Such variation can create inconsistencies in how sounds are represented in writing and may lead to challenges in literacy acquisition and language transmission.

One of the challenges in developing orthography for languages in East Nusa Tenggara concerns the representation of implosive consonants, which are relatively rare across the world's languages but occur in several languages of the region (Grimes, 1999; Mori, 2023; Tamelan, 2021). Because implosive consonants do not occur in Indonesian, the national language, researchers and language practitioners often adopt different strategies for representing these sounds in writing. As a result, multiple orthographic representations of implosive consonants currently coexist in some languages of East Nusa Tenggara. Furthermore, there is often no in-depth phonological analysis of the phonetic status of these sounds in certain languages, resulting in inconsistent representation. For example, the phonological status of implosives in some languages of Rote is unknown (Edwards, 2018).

The Dhao and Hawu languages feature four implosive consonants, while certain languages in Rote, Flores, and Sumba have two to three implosives (Arka, 2016; Grimes, 2010; Klamer, 1998; Tamelan, 2021). The phonetics of the implosive consonants have been described for some of these languages; however, they remain unknown in others. The geographical distribution of the languages discussed in this study is shown in Figure 1.

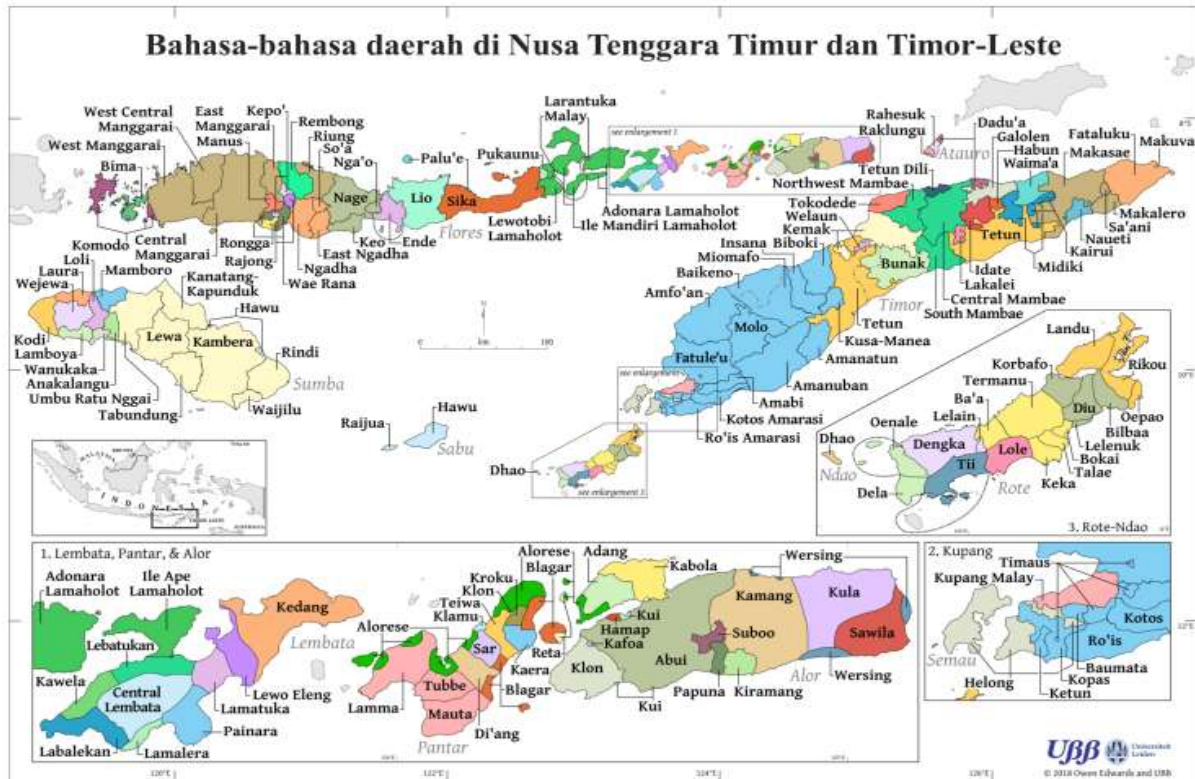


Figure 1. Languages map of NTT and Timor Leste (Edwards & UBB GMIT, 2018)

While implosives are rarely found in the world's languages, the data in Table 1 indicate that they are present in several languages in East Nusa Tenggara.

Table 1. Implosive consonants in languages of East Nusa Tenggara

Languages	Implosive consonants			
	Bilabial /b/	Alveolar /d/	Palatal /j/	Velar /g/
Dela (Tamelan, 2021, 2024)	6	d		
Dengka (Edwards, 2021)		d*		
Tii and Lole (UBB)	6	d		
Termanu (Edwards, 2021)	6*	d*		
Rikou (Edwards, 2021)		d*		
Dhao (Balukh, 2020; Grimes, 2010)	6	d	ʃ	g
Hawu (UBB, 2006)	6	d	ʃ	g
Kambera (Klamer)	6	d		
Rongga (Arka, 2016)	6	d		g

*imploded intervocalic

As shown in Table 1, most languages in Rote have only two implosives: the bilabial and alveolar implosives /b/ and /d/. The two implosives are phonemic in all positions in Dela, Tii, and Lole. In contrast, Dengka and Termanu only have the implosive /d/ in intervocalic positions. Hawu and Dhao, however, have a more extensive set of implosives consisting of bilabial /b/, alveolar /d/, palatal /j/, and velar /g/. These implosives are phonemically distinct from their plosive counterparts. Rongga has three implosives: the bilabial /b/, alveolar /d/, and velar /g/. Unlike Dhao, Hawu, and Rongga, the implosives

in Kambera and Rote languages do not have voiced plosive counterparts, as indicated in Table 2. The phonological status of the two-voiced plosives in other Rote varieties remain unknown.

Table 2. Implosive consonants and their stop counterparts

Languages	Implosive and Plosive Consonants							
	/b/	/ɓ/	/d/	/ɗ/	/j/	/ɟ/	/g/	/ɡ/
Dela (Tamelan, 2021, 2024)		ɓ		ɗ			g	
Dengka (Edwards, 2021)	b		d	ɗ				
Tii and Lole (UBB)		ɓ		ɗ				
Termanu (Edwards, 2021)	b		d	ɗ				
Rikou (Edwards, 2021)	b		d	ɗ				
Dhao (Balukh, 2020; Grimes, 2010)	b	ɓ	d	ɗ	j	ɟ	g	ɡ
Hawu (UBB, 2006)	b	ɓ	d	ɗ	j	ɟ	g	ɡ
Kambera (Klamer)	b	ɓ	d	ɗ				
Rongga (Arka, 2016)	b	ɓ	d	ɗ			g	ɡ

To design an effective orthography, several key factors must be taken into account, including linguistics, sociolinguistics, pedagogical or educational principles, and practical considerations (Cahill & Karan, 2008; Seifart, 2006). From a linguistic perspective, the key goal is to follow the principle of “one phoneme, one symbol”. This means that ideally, each sound in the language corresponds to a single letter to make the orthography clear and straightforward. That is, only phonemic sounds are represented in the orthography. Such transparency remains crucial in orthography design (Cahill & Karan, 2008; Jany, 2010). Research has shown that transparent orthographies, which feature consistent sound-symbol correspondences, are learned more quickly than less transparent orthographies with inconsistent and irregular spellings (Caravolas et al., 2013; Ziegler et al., 2010). In terms of sociolinguistics, it is essential for an orthography to gain acceptance from all stakeholders, as orthographies have political implications. This aspect includes the attitude of native speakers towards their own language, as well as towards other languages, including national and neighboring languages, and it is influenced by local language policy.

For an orthography to be effective in education, it should be easy to learn and applicable to related languages. The reading and writing processes can become more complicated when there are discrepancies between spoken and written forms of a language. Additionally, having different alphabet options for representing the same sounds in closely related languages may hinder the transfer of skills to those languages. Other issues that need to be considered are the choice of letters of the alphabet, word breaks, and the representation of suprasegmentals (Cahill & Karan, 2008). While an effective orthography must consider linguistics, sociolinguistics, pedagogical or educational principles, and practical aspects, these often conflict with one another. When a conflict arises, an acceptable balance of linguistic and other principles must be considered (Baird & Klamer, 2006; Seifart, 2006).

Despite increasing efforts to develop orthographies for the languages of East Nusa Tenggara, the representation of implosive consonants remains inconsistent across languages and institutions. Previous studies have primarily documented the phonological systems of individual languages or proposed orthographies within specific institutional contexts (e.g., Arka, 2016; Edwards, 2018; Grimes, 2010; Klamer, 1998; Tamelan, 2021). However, little attention has been given to evaluating these orthographic conventions comparatively. As a result, multiple orthographic systems currently coexist for the same phonological features, making it difficult to determine which representations most effectively reflect phonological distinctions while supporting literacy development. This lack of comparative evaluation presents both a theoretical and a practical problem. Theoretically, it limits our understanding of how orthographic principles such as phoneme–grapheme transparency are implemented across related languages. Practically, it may contribute to inconsistent literacy materials, create uncertainty for teachers and learners, and complicate multilingual education where different orthographic conventions are encountered. Addressing this problem requires a systematic comparison of existing orthographic practices and an evaluation of their pedagogical implications.

Theoretically, this study contributes to orthography development research by providing a comparative analysis of the representation of implosive consonants across eight languages of East Nusa

Tenggara. By applying the principles of phoneme–grapheme transparency and orthographic consistency, it extends discussions of orthographic design to minority Austronesian languages that have received limited comparative attention.

In practice, the study examines how different orthographic representations may influence reading and pronunciation through orthographic testing with speakers of Hawu and Dela. The findings are intended to inform educators, language practitioners, and speech communities in the development of orthographic conventions that support multilingual literacy while respecting community preferences and institutional practices.

The analysis of the orthography of implosive consonants in languages of East Nusa Tenggara is based on the research conducted by Cahill & Karan (2008) and Seifart (2006). This study aims to provide insights for creating standardized orthographies for closely related languages, such as those spoken in Rote and Hawu islands. The findings will contribute to ongoing efforts to preserve and revitalize local languages. Ultimately, this study calls for collaboration among researchers, institutions, policymakers, and educators to develop standardized orthographies for local languages in the East Nusa Tenggara region. Transparent orthographies will help create resources for multilingual education, supporting diverse linguistic communities. This study contributes to ongoing discussions in orthography development by demonstrating how orthographic variation in minority languages may influence literacy acquisition and language maintenance in multilingual settings.

METHOD

This study employs a comparative qualitative design combining documentary analysis and classroom-based orthography testing to examine how implosive consonants are represented in existing orthographies and to evaluate the pedagogical implications of these representations. The comparative design enables systematic analysis of orthographic representations across languages and institutions while relating documentary evidence to observations from orthography testing. The analysis focuses on eight languages of East Nusa Tenggara reported to contain implosive consonants: Dela, Tii, Lole, Termanu, Dhao, Hawu, Kampera, and Rongga (Arka, 2016; Edwards, 2021; Grimes, 2010; Klamer, 1998; Tamelan, 2021).

The documentary data were analysed using a comparative qualitative framework adapted from Cahill and Karan (2008) and Seifart (2006). Each orthographic system was examined according to two analytical principles: (1) phoneme–grapheme transparency and (2) consistency of grapheme–phoneme correspondence. Orthographic representations were then compared across languages and institutional traditions to identify recurring patterns of similarity and variation.

The study draws on two sources of data. First, a documentary analysis was conducted on linguistic publications, grammars, and community materials produced by different institutions and researchers, including publications by Unit Bahasa dan Budaya (UBB), Lembaga Alkitab Indonesia (LAI), and individual scholars. This analysis aimed to identify the orthographic symbols used to represent implosive consonants across languages and orthographic traditions. Second, orthography testing was conducted in two languages, Hawu and Dela. These languages were selected because they represent different patterns of orthographic variation. Hawu illustrates a situation where multiple orthographic systems coexist within the same speech community, whereas Dela demonstrates variation within a single orthographic system depending on the phonological position of implosive consonants.

The first author is a native speaker of Dela-Rote. This positional knowledge supported the interpretation of phonological patterns and orthographic representations. To reduce potential bias, interpretations were cross-checked through documentary evidence and discussions with other researchers and native speakers during the testing sessions.

The orthography testing involved 30 native speakers: 10 elementary school students and 5 teachers from each language community. Students (aged approximately 9–12) were selected as beginning readers, who are particularly sensitive to orthographic transparency, while teachers were included because they regularly use local-language materials in literacy instruction.

Participants were asked to read short texts containing words with implosive consonants. Participants completed the reading tasks individually by reading the texts aloud while the researchers observed their performance. With participants' consent, the reading sessions were audio-recorded to facilitate

subsequent analysis. An observation checklist was used to document pronunciation substitutions, reading hesitations, self-corrections, and requests for clarification. Reading hesitations were operationally defined as pauses of approximately two seconds or longer before or during word pronunciation. These observations were compared across participants and later discussed during follow-up group discussions to better understand participants' perceptions of the orthographic systems.

The reading activities were followed by informal group discussions to gather participants' perspectives on the clarity and usability of the orthographies. In Hawu, participants read approximately two pages of texts taken from three publications that use different orthographic systems: UBB, LAI, and Paddi (2019). These texts contain multiple examples of implosive consonants in different phonological environments. Participants read the texts aloud while the researchers observed pronunciation patterns, reading hesitations, and potential difficulties related to the representation of implosive consonants. In Dela, participants read texts written in the UBB orthography. In this system, the implosives /b/ and /d/ are written as and <d> in word-initial position and as <b'> and <d'> in medial positions. This positional variation allows the study to examine how multiple orthographic representations of the same phoneme influence reading and interpretation.

During the reading sessions, the researchers documented pronunciation errors and reading hesitations through field notes. Pronunciation errors occurred when implosive consonants were replaced with their plosive counterparts. The discussions that followed the reading activities provided additional insights into participants' perceptions of the orthographies.

The analysis evaluated orthographic representations according to two principles widely used in orthography development research: phonemic transparency and consistency of grapheme–phoneme correspondence (Cahill & Karan, 2008; Seifart, 2006). For this study, underrepresentation refers to situations in which two or more phonemes are represented by the same grapheme, thereby reducing phonemic distinction in writing. Overrepresentation refers to situations in which a single phoneme is represented by multiple graphemes within the same orthographic system or across orthographic traditions. These categories provided the analytical basis for evaluating orthographic transparency and consistency.

Orthographic symbols representing implosive phonemes were first identified and classified according to their grapheme–phoneme correspondences. The representations were then compared across languages and orthographic traditions to identify recurring patterns of underrepresentation and overrepresentation. Finally, these patterns were interpreted in relation to the principles of phonemic transparency and orthographic consistency proposed by Cahill and Karan (2008) and Seifart (2006).

To strengthen the credibility of the findings, methodological triangulation was employed by comparing evidence from three complementary sources: (1) documentary analysis of published orthographies, (2) observations from classroom-based reading activities, and (3) participants' comments obtained during follow-up group discussions. Interpretations were considered robust when similar patterns emerged consistently across these three sources.

RESULTS AND DISCUSSION

Results

The results of the data analysis address the two research questions of this study: (1) how implosive phonemes are represented in existing orthographies of languages in East Nusa Tenggara, and (2) what pedagogical implications arise from these orthographic representations. The analysis reveals two main patterns. First, multiple orthographic conventions are used to represent implosive phonemes both across languages and within individual languages. Second, these variations may create challenges for language learners, particularly beginning readers, because the relationship between sounds and their written representations is not always consistent. The findings are presented in three subsections: (1) cross-linguistic variation in orthographic representations, (2) the case of Hawu, where multiple orthographic systems coexist within the community, and (3) the case of Dela, where positional variation results in multiple representations of the same phoneme.

Cross-Linguistic Variation in Orthographic Representations

Across the languages examined in this study, implosive consonants are represented using different orthographic symbols depending on the language and institutional tradition. Table 3 summarizes the orthographic representations found in the eight languages examined.

Table 3. The representation of the implosive consonants in the existing orthographies

Languages	Implosive consonants and their orthographic representations			
	Bilabial /b/	Alveolar /d/	Palatal /j/	Velar /g/
Dela-Rote (UBB, 2020)	6 , <b'>	d' <d>, <d'>		
Tii and Lole-Rote (UBB)	6 	d' <d>		
Termanu-Rote (UBB)	6* <b'>	d* <d'>		
Termanu-Rote (LAI)	6* 	d* <d>		
Dhao (UBB)	6 <b'>	d' <d'>	f <j'>	g' <g'>
Hawu (UBB, 2006)	6 <b'>	d' <d'>	f <j'>	g' <g'>
Hawu (Bire, 2024; LAI, 2000)	6 <bh>	d' <dh>	f <jh>	g' <gh>
Hawu (Paddi, 2019)	6 	d' <d>	f <j>	g' <g>
Kamera (Klamer, 1998)	6 	d' <d>		
Rongga (Arka, 2016)	6 <bh>	d' <dh>		g' <gh>

*imploded intervocalic

As shown in Table 3, all orthographies employ Roman letters for compatibility with Indonesian orthography. However, different institutions use different conventions to represent implosive phonemes. The two main institutions with the most published works in local languages in East Nusa Tenggara, UBB (Language and Culture Unit) and LAI (Indonesian Bible Institute), use different symbols to denote implosive phonemes. UBB represents implosive consonants in two ways: 1) by using the base consonant followed by an apostrophe (for example, <b'> for the bilabial implosive in Hawu and Dhao, as well as intervocalic implosives in Dela and Termanu), and 2) non-phonemically, using and <d> for Lole, Tii, and word-initial implosives in Dela. LAI, in contrast, uses two different symbols for implosive consonants across the eight languages: 1) the base consonant followed by the letter <h> (for instance, the bilabial implosive is represented as <bh> in Hawu), and 2) an apostrophe followed by the base consonant, like [C] for the implosives in Termanu-Rote. In addition, some individual researchers such as Klamer (1998) and Paddi (2019) use non-phonemic representations in which implosive consonants are written using the same symbols as their plosive counterparts (e.g., and <d>). These differences demonstrate that no single orthographic convention has been consistently adopted across the languages studied. As shown in Table 3, the same implosive phoneme may therefore be represented using several different symbols depending on the orthographic tradition followed by a particular institution or researcher.

These findings address the first research question by demonstrating that implosive phonemes are represented through multiple orthographic conventions across languages and institutions in East Nusa Tenggara. This pattern suggests that orthographic variation is driven less by phonological differences among languages than by institutional conventions adopted during orthography development. Consequently, closely related languages sometimes display greater orthographic variation than would be expected from their phonological systems alone.

The Case of Hawu: Coexisting Orthographic Systems

The Hawu language provides a clear example of how multiple orthographic systems can coexist within a single speech community. The analysis shows that three different orthographic conventions are currently used in Hawu publications: those developed by UBB, LAI, and Paddi (2019). Each of these orthographies represents implosive consonants using different symbols. For example, the bilabial implosive /b/ is represented as <b'> in UBB materials, <bh> in LAI publications, and in the orthography used by Paddi. Similar variation occurs for the other implosive consonants /d/, /j/, and /g/.

As a result, the same Hawu word may appear with different spellings depending on the orthographic system used.

Table 4 presents examples of Hawu words written using the three orthographic conventions. For instance, the word meaning ‘buffalo’ may appear as *b'ara*, *bhara*, or *bara* depending on the orthography. Such variation can create challenges for readers, particularly for young learners who are still developing literacy skills. When learners encounter the same word written in multiple ways, it may disrupt word recognition and slow down the development of reading fluency.

Table 4. Examples of Hawu words written with different existing orthographies

Hawu words		Implosive consonants and their orthographic representation		
		UBB (2006)	LAI (2000)	Paddi (2019)
Bilabial /b/				
<i>buke</i>	‘nothing’	<i>b'uke</i>	<i>bhuke</i>	<i>Buke</i>
<i>bara</i>	‘buffalo’	<i>b'ara</i>	<i>bhara</i>	<i>Bara</i>
<i>kebara</i>	‘floating’	<i>keb'ara</i>	<i>kebhara</i>	<i>Kebara</i>
<i>bado</i>	‘flower’	<i>b'èdo</i>	<i>bhaddo</i>	<i>Baddo</i>
alveolar /d/				
<i>dara</i>	‘this’	<i>d'ara</i>	<i>dhara</i>	<i>Dara</i>
<i>due</i>	‘two’	<i>d'ue</i>	<i>dhue</i>	<i>Due</i>
<i>dodo madi</i>	‘happen’	<i>dod'o mèd'i</i>	<i>dodho maddhi</i>	<i>dodo maddi</i>
<i>merada</i>	‘wilderness’	<i>merèd'a</i>	<i>meraddha</i>	<i>Meradda</i>
palatal /ʃ/				
<i>ʃara</i>	‘about’	<i>j'ara</i>	<i>jhara</i>	<i>Jara</i>
<i>ʃala</i>	‘fisherman’	<i>j'ala</i>	<i>jhala</i>	<i>Jala</i>
<i>bəfi</i>	‘sleep’	<i>bəj'i</i>	<i>bbajhi</i>	<i>Bbaji</i>
<i>rufara</i>	‘road’	<i>ruj'ara</i>	<i>rujhara</i>	<i>Rujara</i>
velar /g/				
<i>gətu</i>	‘pick’	<i>g'etu</i>	<i>ghattu</i>	<i>Gattu</i>
<i>megifi</i>	‘shiver’	<i>meg'ig'i</i>	<i>meghighi</i>	<i>Megigi</i>
<i>haga dara</i>	‘God’s word’	<i>hag'a d'ara</i>	<i>hagha dhara</i>	<i>haga dara</i>

The orthography testing conducted with Hawu speakers also revealed that some participants experienced difficulties when reading texts that used orthographic representations which did not clearly distinguish implosive consonants from their plosive counterparts. These findings suggest that orthographic inconsistency may increase the cognitive demands placed on beginning readers.

The Hawu case demonstrates that orthographic inconsistency can arise even when speakers share the same phonological system. The observed reading hesitations suggest that learners must first identify which orthographic convention is being used before decoding the text, thereby increasing processing demands. This case illustrates how different orthographic traditions within a single speech community contribute to variation in the representation of implosive phonemes, providing further evidence for the patterns identified in the first research question.

The Case of Dela: Positional Variation in Orthographic Representation

Unlike Hawu, where multiple orthographic systems coexist, the Dela orthography mainly follows a single convention developed by UBB. However, within this orthographic system implosive consonants are represented differently depending on their position within a word.

In Dela, the bilabial and alveolar implosives /b/ and /d/ are written using the base consonants and <d> when they occur in word-initial position, but they are represented using <b'> and <d'> when they occur in medial positions. This positional variation results in two different written representations for the same phoneme. Examples of this pattern are presented in Table 5. For instance, the implosive /b/ appears as in word-initial position but as <b'> in medial position. Although this system attempts to

represent implosives more explicitly in certain contexts, it may also introduce confusion for readers because the same phoneme is written using two different symbols.

Table 5. The representation of implosive consonants in Rote speech varieties

Words		Implosive consonants & their representation	
Dela: /b/ and /d/	(UBB)	LAI	
<i>bubu</i>	‘porridge’	<i>bub'u</i>	
<i>baba?e</i>	‘divide’	<i>bab'a'e</i>	
<i>dedeat</i>	‘language’	<i>d'ed'eat</i>	
<i>na?ada?adi?</i>	‘create’	<i>na'ad'ad'ad'i'</i>	
Tii: /b/ and /d/			
<i>boe</i>	‘also’	<i>Boe</i>	
<i>baba?e</i>	‘divide’	<i>baba'e</i>	
<i>dede?ak</i>	‘language’	<i>dede'ak</i>	
<i>nakada?adik</i>	‘create’	<i>Nakadadadik</i>	
Termanu /b/ and /d/			
<i>soba</i>	‘try’	<i>sob'a</i>	<i>so'ba</i>
<i>tabu</i>	‘step’	<i>tab'u</i>	<i>ta'bu</i>
<i>nade</i>	‘name’	<i>nad'e</i>	<i>na'de</i>
<i>dadi</i>	‘so’	<i>dad'i</i>	<i>da'di</i>

Observations from orthography testing suggest that this positional variation may create difficulties for teachers and young learners. Because a single phoneme is represented by more than one symbol, learners must remember additional spelling rules that are not directly related to pronunciation. These findings show that even within a single orthographic system, positional variation in representing implosive consonants may introduce additional complexity for learners, highlighting the pedagogical implications addressed in the second research question.

Unlike Hawu, variation in Dela originates from positional spelling rules rather than competing orthographies. This distinction indicates that both inter-system and intra-system inconsistencies may influence orthographic transparency through different mechanisms.

Taken together, these findings show that orthographic variation in the representation of implosive consonants occurs both across languages and within individual languages, raising important questions about orthographic transparency and its implications for literacy development.

Discussion

The findings of this study address two main research questions: (1) how implosive phonemes are represented in existing orthographies of languages in East Nusa Tenggara, and (2) what pedagogical implications arise from these orthographic representations. The results demonstrate that implosive consonants are represented through multiple orthographic conventions across languages and institutions. These variations influence orthographic transparency and have implications not only for literacy development but also for language practices and the maintenance of phonological distinctions in multilingual contexts.

Orthographic Transparency and the Representation of Implosive Phonemes

The first research question concerns how implosive phonemes are represented in the orthographies of languages in East Nusa Tenggara. Rather than reflecting major phonological differences among the languages, the observed variation largely reflects different orthographic decisions adopted by institutions and researchers. This suggests that orthographic diversity in East Nusa Tenggara is shaped not only by linguistic structure but also by independent traditions of language documentation and literacy development. Consequently, closely related languages may employ markedly different writing systems despite having similar phonological inventories.

From the perspective of orthography design, these strategies reflect different levels of orthographic transparency. Transparent orthographies typically maintain consistent grapheme–phoneme correspondences in which each phoneme is represented by a single symbol (Cahill & Karan, 2008; Seifart, 2006). Such transparency facilitates both reading acquisition and phonological awareness because readers can reliably associate written symbols with specific sounds.

Orthographic representation may also influence how speakers perceive and produce phonological contrasts. Experimental studies have shown that written forms can shape learners' pronunciation patterns during reading tasks, as orthographic cues guide phonological interpretation (Bassetti & Atkinson, 2015). In languages where implosives contrast with plosive consonants, consistent orthographic representation therefore plays an important role in reinforcing these phonemic distinctions. Phonological contrasts such as implosives and plosives constitute meaningful elements of the sound systems of languages and are essential components of phonological structure (Fromkin, Rodman, & Hyams, 2007).

The analysis reveals two types of orthographic inconsistency. The first is underrepresentation, in which implosive consonants are written using the same symbols as their plosive counterparts. This pattern appears in the orthographies used by Paddi (2019), Klammer (1998), and some UBB publications for languages such as Tii, Lole, and Kambara. The second is overrepresentation, in which the same phoneme is represented by different symbols depending on phonological context. This pattern occurs in the Dela orthography, where implosives are written as and <d> in word-initial position but as <b'> and <d'> in medial positions.

Both types of representation may reduce orthographic transparency because they weaken the systematic relationship between phonemes and graphemes. Readers may therefore encounter situations where different sounds are represented by the same letter or where the same sound appears in multiple written forms. These findings indicate that the principle of "one phoneme—one symbol," widely recommended in orthography development (Cahill & Karan, 2008), is not consistently applied across the languages examined in this study.

Institutional Orthographic Practices and Cross-Linguistic Variation

The findings also demonstrate that orthographic variation in East Nusa Tenggara is shaped not only by linguistic considerations but also by institutional practices. Two institutions in particular—Unit Bahasa dan Budaya (UBB) and Lembaga Alkitab Indonesia (LAI)—have played major roles in producing written materials in local languages. However, each institution has adopted different conventions for representing implosive consonants. Table 6 illustrates these institutional differences by comparing the representation of implosive and plosive consonants in Termanu and Hawu orthographies.

Table 6. Representation of Termanu & Hawu implosives & their plosive counterparts

Publications	Implosive phonemes				Stop phonemes			
	/b/	/d/	/j/	/g/	/b/	/d/	/dʒ/	/g/
Termanu: UBB	<b'>*	<d'>*				<d>		
Termanu: LAI	<'b>*	<'d>*				<d>		
Hawu: UBB	<b'>	<d'>	<j'>	<g'>		<d>	<j>	<g>
Hawu: LAI	<bh>	<dh>	<jh>	<gh>		<d>	<j>	<g>
Hawu: Paddi		<d>	<j>	<g>		<d>	<j>	<g>

*imploded intervocalic

These institutional differences illustrate that orthographic conventions emerge through historical, educational, and organizational processes rather than through linguistic analysis alone. The coexistence of multiple conventions therefore, reflects parallel orthography development rather than disagreement about the underlying phonological system. This finding highlights the importance of coordinated language planning when several organizations produce literacy materials for the same speech community.

Implications for Literacy Development in Multilingual Contexts

The second research question concerns the pedagogical implications of these orthographic representations. The orthography testing conducted in Hawu and Dela provides empirical evidence that orthographic transparency plays an important role in literacy development.

Observations from the orthography testing suggest that inconsistent grapheme–phoneme correspondences may increase the cognitive demands placed on beginning readers. Reading hesitations and pronunciation substitutions were observed most frequently when participants encountered unfamiliar orthographic representations or systems that did not consistently distinguish implosive consonants from their plosive counterparts.

Research on literacy acquisition consistently shows that transparent orthographies—those with clear and consistent sound–symbol correspondences—are easier for beginning readers to learn (Cahill, 2014; Caravolas et al., 2013; Sandra et al., 2024). When grapheme–phoneme relationships are predictable, learners can apply phonological decoding strategies more effectively when reading unfamiliar words. Cross-linguistic

studies further demonstrate that phonological decoding is a key predictor of early reading development across writing systems (Landerl, Castles, & Parrila, 2022).

Conversely, orthographies with inconsistent grapheme–phoneme correspondences increase the cognitive demands of reading. Beginning readers typically process written words by decoding individual graphemes rather than relying on contextual cues (Verhoeven & Perfetti, 2022). Studies of orthographic development also show that children learning transparent orthographies tend to acquire decoding skills more rapidly than those learning less consistent systems (Seymour et al, 2003). These findings reinforce the importance of maintaining transparent grapheme–phoneme mappings in orthography design.

The effects of orthographic underrepresentation are particularly visible in Hawu minimal pairs, as illustrated in Table 7.

Table 7. Minimal pairs of Hawu implosives and their stop counterparts in the orthographies

	Word	UBB	LAI	Paddi
	ʃəla	b'èla	bhallā	balla
	Bəla	bèla	balla	balla
	dəno	d'èno	dhanno	danno
	Dəno	dèno	danno	Danno
	ʃara	j'ara	jhara	Jara
	Jara	jara	jara	Jara
	həʃa	həg'a	haggha	Hagga
	Həga	hèga	hagga	Hagga

In the orthography used by Paddi (2019), implosive consonants are written using the same letters as their plosive counterparts. Consequently, minimal pairs such as ʃəla ‘sheet’ and bəla ‘wide’ appear with identical spellings. When orthography fails to represent phonemic contrasts explicitly, readers must rely on contextual information to interpret meaning. Such ambiguity can complicate reading processes, especially for learners who are still developing phonological awareness.

These observations suggest that orthographic transparency becomes particularly important when phonological contrasts carry lexical meaning. When distinct phonemes are represented by identical graphemes, readers may need to rely more heavily on contextual information, potentially increasing decoding demands during early literacy development.

The presence of multiple orthographic systems within a single speech community may further increase these challenges. In Hawu, speakers encounter three different orthographic conventions in publications produced by UBB, LAI, and Paddi. When the same word appears with different spellings across texts, readers must interpret multiple grapheme–phoneme correspondences for the same sound.

The orthography testing also revealed sociolinguistic differences in orthographic preference. Older speakers who are familiar with religious publications produced by LAI often prefer the LAI orthography, whereas younger speakers who have been exposed to educational materials produced by UBB through multilingual education programs tend to prefer the UBB system. These patterns suggest that orthographic practices are shaped not only by linguistic factors but also by patterns of exposure and institutional influence.

Similar pedagogical challenges arise in the case of Dela. In this orthography, implosive consonants are represented differently depending on their position within a word. Teachers participating in the orthography testing reported that explaining these positional spelling rules can be difficult when teaching early literacy skills. Because learners must remember multiple orthographic forms for the same sound, the system may increase the complexity of reading instruction. Unlike the Hawu case, where inconsistency results from competing orthographic traditions, the Dela case demonstrates that inconsistency may also arise within a single orthographic system through positional spelling rules. These findings suggest that both inter-system and intra-system variation may influence orthographic transparency through different mechanisms.

Research on orthography instruction emphasizes that learners benefit from systems in which spelling conventions correspond closely to phonological patterns (Januševa & Jurukovska, 2017). Clear and consistent spelling conventions therefore play an important role in supporting the development of basic reading and spelling skills (Harsanti, 2020). In multilingual educational contexts, orthographic transparency may also facilitate the transfer of reading skills across languages, whereas inconsistent orthographies may create additional cognitive demands for learners navigating multiple writing systems (Garton, 2023; Cahill & Keren, 2010).

Implications for Language Maintenance and Linguistic Diversity

Beyond literacy development, the findings also raise broader questions about the relationship between orthographic practices and language maintenance. In multilingual regions such as East Nusa Tenggara, local languages coexist with Indonesian, which does not contain implosive consonants.

When orthographies fail to clearly represent implosive consonants, speakers may become less aware of these phonological distinctions during literacy development. Observations from the orthography testing indicate that some young readers occasionally pronounced implosive consonants as their plosive counterparts when reading texts in which these sounds were not clearly represented.

However, these observations should be interpreted cautiously. The present study does not investigate long-term phonological change. Rather, the findings suggest that orthographic representation may influence how learners perceive phonological contrasts during early stages of literacy development.

Research on language change suggests that phonological systems may gradually evolve in multilingual contexts as speakers adapt their pronunciation patterns in response to social and linguistic influences (Thomas, 2021). In communities where smaller languages coexist with dominant languages, phonological distinctions may become less prominent if they are not consistently reinforced through speech and writing practices (Huszka et al., 2025).

Distinctive phonological features such as implosive consonants form part of the linguistic identity of many languages in East Nusa Tenggara. The preservation of such features contributes to the maintenance of linguistic diversity and cultural heritage (Harrison, 2007). Clear and consistent orthographic representation may therefore help reinforce speakers' awareness of these phonological distinctions during literacy development.

Toward More Consistent Orthographic Conventions

The findings suggest that orthographic systems maintaining clear and consistent phoneme–grapheme correspondences are likely to support early literacy more effectively. Among the orthographic systems examined, the UBB convention demonstrates several linguistic advantages with respect to phonemic transparency because it consistently distinguishes implosive consonants from their plosive counterparts while maintaining a one-to-one correspondence between phonemes and graphemes. This convention also avoids potential ambiguity that may arise when implosives are represented by the same symbols as plosives.

The orthography testing further indicates that orthographic preferences are influenced not only by linguistic considerations but also by patterns of community use and institutional history. In the Hawu community, many younger speakers were more familiar with the UBB convention because it has been adopted in multilingual educational materials used in elementary schools. In contrast, many older speakers expressed greater familiarity with the LAI convention, reflecting its long-standing use in Bible translations and other religious publications. These findings demonstrate that orthographic preferences are shaped by exposure through different social institutions, particularly schools and churches.

Taken together, the linguistic analysis and community observations suggest that the UBB convention offers several advantages for literacy development in Hawu. Its transparent representation of implosive consonants is consistent with established principles of orthography design (Cahill & Karan, 2008; Seifart, 2006), and its increasing familiarity among younger readers may facilitate the use of orthographic materials in school settings. Nevertheless, this should not be interpreted as the sole acceptable orthographic solution. Orthographic decisions should ultimately balance linguistic efficiency with community preferences, historical usage, institutional practices, and educational feasibility through continued consultation among researchers, educators, and speech communities.

For Dela, the findings suggest that orthographic transparency could be improved by representing each implosive phoneme with a single grapheme throughout all phonological environments. Rather than using and <b'> or <d> and <d'> for the same phoneme depending on word position, adopting a single representation (and <d>) would provide more consistent grapheme–phoneme correspondence and reduce the need for learners to acquire additional positional spelling rules. Such a revision may simplify early literacy instruction while preserving the phonological distinction between implosive and non-implosive consonants.

Overall, this study does not advocate a uniform orthographic solution for all languages of East Nusa Tenggara. Instead, it suggests that future orthography development should seek an appropriate balance between phonological transparency, educational effectiveness, institutional continuity, and the preferences of the speech communities themselves.

Scope and Limitations of the Findings

This study has several limitations. First, orthography testing was conducted only in Hawu and Dela and involved a relatively small number of participants. Second, the study examined short-term reading performance rather than long-term literacy development. Consequently, the pedagogical implications should be interpreted as indicative rather than conclusive. Future research involving additional language communities, larger participant groups, and longitudinal literacy assessments would provide stronger evidence concerning the relationship between orthographic transparency and reading development.

CONCLUSION

This study examined the representation of implosive consonants in the orthographies of eight languages of East Nusa Tenggara and explored the pedagogical implications of these orthographic practices. The comparative analysis indicates that orthographic variation reflects not only differences in linguistic representation but also the influence of institutional traditions and community practices. Across the orthographies examined, cases of underrepresentation and overrepresentation suggest that the principle of consistent phoneme–grapheme correspondence is applied unevenly.

Observations from orthography testing in Hawu and Dela suggest that orthographic transparency may influence beginning readers' decoding of implosive consonants and may increase the complexity of early literacy instruction when multiple representations of the same phoneme are used. The findings also indicate that orthographic preferences are shaped by patterns of exposure through educational and religious institutions, highlighting that orthography development is both a linguistic and a sociocultural process.

Rather than advocating a single orthographic solution for all languages, this study suggests that orthographic development should balance phonemic transparency with community preferences, historical usage, institutional practices, and educational feasibility. Within the contexts examined, the UBB convention demonstrates several linguistic advantages for Hawu, while a single grapheme representation for implosives may provide a more consistent orthographic system for Dela. These observations should be interpreted within the scope of the present study, which was based on documentary analysis and orthography testing in two language communities.

Future research should extend orthography testing to additional languages and larger participant groups and examine the long-term relationship between orthographic transparency and literacy development. Such work would provide stronger empirical evidence to support collaborative orthography development for the languages of East Nusa Tenggara.

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