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Literature Review of Errors in Spelling English Consonants and Vowels by Arabic Speakers and Remedial Interventions

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Abstract

Spelling remains a fundamental skill to acquire because it is foundational for successful literacy attainment, even with the advancement of technological writing tools. Nevertheless, it is an understudied skill in research, especially among language learners. This literature review aims to shed light on the English spelling skills of Arabic L1 speakers. The findings are organized around three domains: (1) common errors in English writing made by Arabic L1 speakers, (2) comparative studies examining the English spelling performance of Arabic L1 learners versus learners from other language backgrounds, and (3) effective English spelling interventions for Arabic L1 learners. Synthesizing findings across these studies reveals spelling errors that can be attributed to cross-linguistic transfer from Arabic to English and errors that pertain to the complexity of the English-language orthography, along with promising interventions that can be utilized to improve spelling performance among Arabic speakers. The review concludes with instructional recommendations aligned with research on Arabic L1 learners, including systematic and explicit spelling instruction with attention to pronunciation. It also identifies directions for future research based on current gaps outlined in the available literature. This paper is the first study that synthesizes English spelling errors of Arabic speakers using a unified error classification system while explaining the errors in relation to the developmental stages of spelling acquisition and the influence of L1.

INTRODUCTION

Despite the widespread availability of spellcheck and other writing tools, spelling remains a fundamental skill for literacy (Pan et al., 2021). Spelling and reading engage shared cognitive processes (Rapp & Lipka, 2011) and are closely correlated (Ehri, 1997). Accurate spelling supports fluent reading, which in turn facilitates comprehension by allowing attention to shift to meaning (Snow et al., 2005). Notwithstanding, spelling achievement remains an understudied topic in literacy research, particularly among language learners, especially Arabic-speaking students. Arabic is among the most widely spoken languages globally, and its script is second only to the Roman alphabet in distribution (Saiegh-Haddad & Joshi, 2014). Many English language learners come from Arabic-speaking backgrounds, as several countries in the world, particularly those in the Gulf Cooperation Council (GCC), have adopted English as an official

language. English is also widely taught as a second or foreign language across the region. Arabic speakers also form large communities in many English-speaking countries. Examining English spelling achievement in this population is essential for both supporting literacy development and advancing language acquisition theory.

Spelling acquisition in the first language

Understanding spelling development in English as a first language (L1 hereafter) is important because it provides a baseline for understanding typical stages and challenges of spelling development. This baseline can in turn inform educators' efforts in identifying and addressing the specific difficulties encountered by English as a second language (L2 hereafter) learners. Researchers characterize L1 spelling development through frameworks describing sequential stages, paralleling Piaget's (1971) cognitive development theory, which conceptualizes learning as stage-based. One prominent model originates from Gentry (1982), while a more recent, closely corresponding framework by Bear and colleagues (2015) outlines the stages of spelling development as *emergent*, *letter-name alphabetic*, *within-word patterns*, *syllables and affixes*, and *derivational relations*.

In Bear et al.'s (2015) model, the emergent stage describes writers who do not yet use language conventionally for spelling. Early in this stage, writing resembles scribbles or drawings. Later, children begin incorporating some letters. This stage is largely pre-phonetic, lacking letter-sound associations. Learning the alphabetic principle (the systematic relationship between letters and sounds) marks the transition to the next stage.

The letter-name alphabetic stage coincides with formal reading instruction. A hallmark of this stage is the use of letter names to represent sounds, exemplified by a child's spelling of "when are you coming" as YNRUKM, which is cited in Bear et al. (2015). In this example, Y represents the /w/ sound, N represents the "*en*" sound in "*when*", and *R* and *U* represent the words "*are*" and "*you*". By the end of this stage, children typically master most consonant spellings at word beginnings and endings, represent long vowels (often omitting silent letters and long vowel markers), and segment words into sounds matching many key letter-sound patterns. Bear et al. provide example misspellings such as **hop (hope)*, **grat (great)*, **mes (miss)*, and **mich (much)* for this developmental stage.

The within-word pattern stage reflects a shift from relying solely on sound-to-letter correspondences to recognizing orthographic patterns, including letter chunks and silent vowel markers. Writers consider letter-sound patterns and word patterns simultaneously. Example errors provided by Bear et al. (2015) include **teme (team)*, **gowl (goal)*, **throwe (throw)*, and **cons (cones)*, demonstrating confusion with long vowel markers.

In the syllables and affixes stage, writers consider syllable junctures and morphemes in multisyllabic words. Most monosyllabic words are spelled correctly, but errors occur at multisyllabic syllable junctures, as seen in the example errors **stoped (stopped)* and **hikeing (hiking)*, cited by Bear et al. (2015).

Finally, the derivational relations stage involves understanding how root word derivations affect spelling. Errors like **faverite (favorite)* and **diffrent (different)* cited by Bear et al. (2015) show limited knowledge of derivational relationships and how meaning is preserved despite sound changes in derived words.

Spelling development among language learners

Although this article focuses on Arabic L1 learners, reviewing research on other language groups is essential for a broader understanding of English spelling development among language learners. Studies of diverse populations allow for identifying universal patterns, shared challenges, and language-specific transfer issues from L1 to L2. There is no single framework describing spelling development stages among language learners. However, research consistently shows that L2 speakers tend to transfer linguistic knowledge from L1 into their L2 writing. Cummins' (1979, 1981) Linguistic Interdependence Hypothesis posits that languages share underlying academic proficiencies, such as spelling, even when surface features differ. Learners often transfer L1 phonological awareness into L2, which can support spelling development. For example, those who spell well in L1 and have strong phonological skills often perform better in L2 spelling. In such cases, transfer is positive because L1 strengths support L2 literacy. However, when L1 and L2 differ more significantly, spelling errors unique to that background may occur.

Challenges in English spelling, shaped by the L1 background, often arise from differences in phonological systems. Learners may struggle with English phonemes that are not present in their L1. Spanish speakers, for example, often confuse /b/ and /v/, resulting in errors like **bildich (village)*, due to the similarity between these phonemes in Spanish (Hevia-Tuero et al., 2023). They may confuse /θ/ and /d/, producing **broder (brother)*, since /θ/ does not exist in Spanish. Similarly, Cantonese speakers have difficulty with /θ/ because it is also absent from Cantonese (Wang & Geva, 2003a). Spanish speakers may further simplify final consonant clusters, writing **frien* for *friend*, because such clusters are uncommon in Spanish (Hevia-Tuero et al., 2023). Japanese speakers often confuse /l/ and /r/, leading to errors such as **runch (lunch)*, **labbit (rabbit)*, **walmer (warmer)*, and **grobal (global)* due to the lack of distinction between the /l/ and /r/ phonemes in Japanese (Cook, 1997). Arabic speakers similarly confuse /b/ and /p/ as well as /f/ and /v/ when writing in English, since /p/ and /v/ do not exist in Arabic (Allaith & Joshi, 2011). They may also struggle with /g/ and /tʃ/, which exist in Spoken Arabic but are not represented in Standard Arabic script (Allaith & Joshi, 2013).

The orthographic nature of L1 can also influence spelling development in English. Spanish speakers, for instance, may insert *h* in digraphs, writing **thenager (teenager)* or **fhather (father)* because *h* is a silent letter in Spanish (Hevia-Tuero et al., 2023). They may also use *j* to represent the /h/ sound, as in **japi (happy)*, because *j* carries that sound in Spanish (Fashola et al., 1996; Linder et al., 2022; Sun-Alperin & Wang, 2008). Cantonese speakers, whose L1 uses a logographic system unlike English, may perform poorly on pseudoword spelling tasks that require regular letter-sound correspondences, suggesting reliance on non-phonological strategies when spelling in English (Wang & Geva, 2003b). A different challenge appears among Arabic and Hebrew speakers: vowel processing in English has been found to be more difficult

compared to speakers of alphabetic systems (e.g., French) or logographic systems (e.g., Chinese), as vowels are sparsely represented in Arabic and Hebrew writing (Hayes-Harb, 2006; Martin, 2017; Ryan & Meara, 1991).

At the same time, the orthographic structure of L1 can sometimes facilitate English spelling. Cantonese speakers, for instance, often outperform English L1 peers on tasks involving recognition of legitimate and illegitimate pseudoword spellings, likely due to their experience with logographic systems (Wang & Geva, 2003b). They also tend to demonstrate stronger orthographic knowledge than Korean speakers, whose L1 uses a script language (Hamada & Koda, 2008; Martin, 2017).

Taken together, findings suggest that the phonological and orthographic features of a learner's L1 can both support and interfere with English spelling development. As a result, language learners from diverse backgrounds may exhibit both similar and distinct challenges and strengths.

The Arabic writing system versus the English writing system

The writing systems of Arabic and English differ significantly. English uses the Latin alphabet and is considered morphophonemic because its orthography reflects both sound and meaning. English spelling is governed by several factors, including letter-sound relationships, word origin and history, and morphology (Bear et al., 2015). For instance, spelling *fish* involves directly mapping the sounds /f/, /ɪ/, and /ʃ/ to the graphemes *f*, *i*, and *sh*. In contrast, spelling *chef* requires knowledge of word origin, as /ʃ/ maps to *ch* due to the word's French roots. Words like *catch* and *speech* require awareness of positional generalizations, such as *ch* appearing after vowel digraphs and *tch* in one-syllable words following short vowels. Morphological rules apply to derived forms. For example, *beginning* involves doubling the *n* from *begin*, while *smiling* drops the silent *-e* from *smile*. These complexities contribute to the opacity of English orthography. A single phoneme may be spelled in several ways (*fi<u>sh</u>*, *<u>ch</u>ef*, *na<u>ti</u>on*), and the same letter patterns may represent different sounds (*<u>g</u>iant*, *<u>g</u>oal*). There are also exception words (*the*, *should*, *said*) that do not follow predictable spelling patterns. English heavily relies on vowels, with around twenty vowel sounds represented by a limited number of graphemes built from the letters *a*, *e*, *i*, *o*, *u*, *w*, and *y*. Accordingly, the same letter pattern may represent more than one sound (*p<u>a</u>per*, *t<u>a</u>ll*, *f<u>a</u>st*), and the same sound may be spelled using different letter patterns (*t<u>ea</u>*, *b<u>ee</u>*, *<u>e</u>ven*).

Arabic, in contrast, is a Semitic language that uses the Arabic alphabet. At first glance, Arabic appears to have a simple writing system, with mostly consistent and predictable sound-to-symbol correspondences. Most Arabic words are spelled through direct phoneme-grapheme mapping. However, Arabic orthography is not as shallow as it initially appears. Arabic is a consonantal language that emphasizes consonant representation in writing. It has three primary long vowels, three short vowels, and two diphthongs. While long vowels are represented with letters, short vowels are marked with diacritics. Without these marks, words that differ in pronunciation and meaning, which are often derived from the same root, can appear identical. Despite this, in most real-world contexts, Arabic is written without diacritics (unvowelized). Readers rely on context to infer meaning, and skilled writers spell words correctly without marking short vowels.

Arabic is also characterized by diglossia: two language varieties coexist within one community, and each is used in distinct contexts. Spoken Arabic is used in everyday informal communication and lacks a standardized written form. Standard Arabic, by contrast, is used in writing and formal speech and is strongly tied to education. Although the two varieties overlap in some areas, they differ significantly in phonology, vocabulary, morphology, syntax, and semantics.

The present study

This literature review examines English spelling performance among Arabic speakers. To date, no prior study has analyzed spelling errors in this population in relation to the stages outlined in stage-based models of spelling (e.g., Bear et al., 2015), while accounting for L1 influence through the lens of cross-linguistic transfer theory. This paper contributes to the understanding of spelling achievement in this population, offers research-based instructional recommendations, and suggests directions for future research. It is exploratory in nature and guided by the following research questions:

1. What are the most common errors in the English writing of Arabic L1 speakers when classified using O'Brien et al.'s (2020) phonological, graphemic-orthographic, and morphological-semantic framework?
2. How does the English spelling performance of Arabic L1 learners compare to that of learners from other language backgrounds, particularly regarding overall ability and accuracy in spelling phonemes absent from Arabic?
3. What spelling interventions are most effective in improving English spelling among Arabic L1 learners?

METHODOLOGY

Identification of studies

ERIC and Google Scholar were used to identify relevant research. ERIC was selected primarily for its specialized focus on peer-reviewed education research from diverse international contexts, ensuring access to high-quality, relevant literature. Google Scholar supplemented this search by capturing additional peer-reviewed studies beyond ERIC's scope. Initially, searches using the keywords "spelling Arabic" and "spelling Arab" yielded 68 and 23 results in ERIC (without restrictions) and 183 and 53 in Google Scholar (restricted to titles). A broader Google Scholar search with "spelling Arab OR Arabic" in full texts returned over 74,000 results. The author reviewed the first 600 results, noting that after this point more than 50 consecutive results lacked relevance.

Inclusion and exclusion criteria

The inclusion and exclusion process consisted of several steps. First, all articles from ERIC and the restricted Google Scholar search were compiled. Titles and abstracts were screened for relevance to the research questions, and a list of all pertinent articles was created. Second,

titles from the unrestricted Google Scholar search were examined; if relevant and non-duplicate, abstracts were reviewed and relevant articles were added to the list. Third, to ensure rigor, studies not published in peer-reviewed journals or published in open-access journals not listed in COPE, DOAJ, Scopus, or Web of Science were excluded. This procedure helped avoid citing articles published in potentially predatory journals that could distort findings. Fourth, a full-text review was conducted. Articles were excluded if they did not address the research questions upon closer inspection (studies focused on spelling in Arabic, studies that reported English spelling errors only as part of general error counts without detailing the nature of errors, or studies that did not separate Arabic L1 learners' results from those of other groups). Twenty-one articles met all inclusion criteria.

For transparency, the author initially considered including all available research on English spelling among Arabic L1 learners. However, many studies were of questionable quality. Thus, the third step was introduced to ensure validity. While this procedure limited the number of studies included, it was necessary to maintain confidence in the conclusions.

In summary, included studies had to (1) address at least one research question, (2) be peer-reviewed, and (3) be based on primary data. Excluded studies were those that (1) focused on spelling in Arabic, (2) did not describe the nature of spelling errors, (3) did not isolate Arabic L1 learners' results from other L2 groups, or (4) were published in open-access journals not listed in recognized indexing services.

Data extraction

Articles were first organized into three thematic categories aligned with the research questions: (1) common English spelling errors by Arabic L1 speakers found in writing samples (11 studies), (2) studies comparing the spelling performance of Arabic L1 learners with learners from other language backgrounds (7 studies), and (3) effective spelling interventions for Arabic L1 learners (3 studies).

For the first category, the data extracted and presented in Table 1 includes participant numbers, background, data collection methods, error classification systems, and the most frequently reported spelling errors. When available, frequencies of errors that occurred more than 10% of the time in participants' writings are reported; however, not all studies provided such numerical data. The studies used different classification systems. For example, some treated capitalization as a spelling error, some distinguished vowel and consonant errors while others combined them, and some isolated silent *-e* errors while others grouped them with general omissions. To synthesize findings, the author reclassified errors using a unified system presented in the appendix and detailed in the "Findings and Discussion" section.

For the comparative studies, Table 2 presents participant data, background information, comparison groups, spelling measures, and main findings. These studies fall into two subcategories: those focusing on English phonemes absent from Arabic and those examining overall spelling proficiency.

Table 3 summarizes the intervention studies, including participant data, descriptions of interventions, and reported outcomes. Given that there were only three studies, no subcategories were created.

The extracted data were synthesized to identify patterns and connections across studies, enabling a comprehensive understanding of the topic. These conclusions inform instructional implications and suggest directions for future research.

FINDINGS AND DISCUSSION

Common errors in English writing by Arabic L1 speakers

Table 1

Common errors found in English written essays by Arabic L1 learners

Study	Participants' Background	*N*	Data Source	Classification System*	Most Frequent Spelling Errors Reported
Albesher (2018)	University students in a preparatory English program	100	Writing drafts	Author's	– Errors influenced by Arabic (missing consonants/vowels, consonant clusters, pronunciation of loan words) – Errors related to English orthographic complexity (vowel digraphs, homophones, morphological rules, compounds)
Alenazi et al. (2021)	University students in an English translation program	105	Exam (Arabic text translations)	Cook (1999) & Author's	– Omission (silent letters, final *-e*, full phonemes, doubling rule, *-ly* suffix), 19% – Substitution (mostly vowels, also *p/b*, *f/v*), 16%
Almurashi & Sultan (2023)	University foundation students	80	Essays	Cook (1999)	– Omission, 42% – Substitution, 25% – Insertion, 20% – Transposition, 14% (Most errors involved vowels due to mispronunciation.)
Aloglah (2018)	University students (freshmen and seniors)	64	Essays	None	– Various error types reported; no frequency data provided.
Alsher (2021)	Year 3 & Year 5 engineering students	54	Essays	James (1998)	– Various error types reported; no frequency data provided.
Deacon (2017)	University students in intensive English programs	20	Proficiency essays	Bebout (1985) & Dunlap (2012)	– Graph-choice: 61% vowels, 41% consonants – Insertion: 11% vowels, 24% consonants – Silent omission: 12% vowels, 18% consonants – Salient omission: 14% vowels, 17% consonants
El-Hibir & Al-Taha (1992)	Students who completed four required English courses	150	Compositions, quizzes, and open-ended questions	Author's	– Various error types reported; no frequency data provided.

Study	Participants' Background	*N*	Data Source	Classification System*	Most Frequent Spelling Errors Reported
Haggan (1991)	English majors (remedial course & Year 4 students)	87	Writing exam	Bebout (1985)	– Consonant doubling, 12%-15% – Other consonant errors, 4%-19% – Schwa, 12%-19% – Silent *-e*, 8%-18% – Other vowel errors, 23%-33%
Hamad (2018)	Pre-intermediate general English students	40	Exam essays	None	– Spelling errors accounted for 39% of writing errors. No classification system was used.
Ibrahim (1978)	University English majors	Not reported	Exams, homework, and assignments	Author's	– Various error types reported; no frequency data provided.
Shweba & Mujiyanto (2017)	Year 1 English majors	30	Questionnaire & writing exam	Corder (1974)	– Omission, 53% – Insertion, 24% – Substitution, 18% (Spelling errors made up 16% of all writing errors; no detailed examples were provided about the nature of those errors.)

**Classification systems are reported as cited by the authors of studies.*

Most of the compiled studies were descriptive, categorizing spelling errors found in participants' writing samples. Table 1 lists these studies, detailing participants' backgrounds, data collection and classification methods, and the most frequent errors based on the authors' classification systems.

However, the variety of classification systems made it unfeasible to compare findings across studies. Moreover, these systems did not provide a developmental perspective on spelling errors. For example, an omission error in misspelling *heart* as **hear* (Deacon, 2017) may reflect incomplete phonological representation, whereas an omission error in misspelling *write* as **writ* (Albesher, 2018) suggests unfamiliarity with the silent *-e* generalization.

To synthesize findings and analyze errors developmentally, this study reclassified reported errors using a unified system based on O'Brien et al.'s (2020) error classification framework. The system includes (1) phonological errors, which involve spelling phonemes with patterns that misrepresent sounds, such as allophone use, omissions, or substitutions; (2) graphemic-orthographic errors, which preserve phonological quality but use incorrect graphemes, like letter doubling errors; and (3) morphological-semantic errors, related to meaning, such as unconventional homophone use. These three domains were further subdivided by the present author.

This reclassification consolidates the diverse systems that were used across the studies, offering a clearer, more coherent framework for qualitative interpretations while respecting the original authors' categorizations. It also enables synthesis across articles. The appendix contains a table outlining the reclassified collective spelling errors from the studies in Table 1. Note that the errors listed in the compiled table should be interpreted qualitatively, not quantitatively, as they are based on example errors mapped from the cited studies rather than

error frequency. Quantitative data would strengthen the findings, but the original articles' presentations did not allow for such extraction.

It is worth noting that differences in the classification systems used in this study versus the reviewed studies led to some variations in conclusions. For example, Alenazi et al. (2021) grouped **tickeet/ticket*, **beatch/beach*, and **off/of* as addition errors, whereas this study classified them as phonological, graphemic-orthographic, and morphological-semantic errors, respectively.

Phonological errors

A closer look at the phonological errors reveals few instances of vowel or consonant omissions. Most errors involved incorrect representation of the phoneme sounds. Among consonants, the most commonly reported errors were confusion between *b* and *p*, followed by alternation between *f* and *v*. Vowel errors mainly involved incorrect phoneme-to-grapheme mapping. Short vowels were most affected (e.g., **frant/front*, **coolect/collect*). There were also errors related to long vowels (e.g., **huoman/human*, **belive/believe*), diphthongs (e.g., **geun/gain*, **abaut/about*), and *r*-inflected vowels (e.g., **toghothar/together*, **doktoor/doctor*). Errors occurred in monosyllabic words (e.g., **rid/red*, **eag/egg*) but were more frequently reported in multisyllabic words (e.g., **resamblance/resemblance*, **defination/definition*). Some errors appeared in high-frequency words with predictable letter-sound patterns (e.g., **lave/love,* **git/get*, **abuot/about*), while others involved less common words with more complex spellings (e.g., **neocliar/nuclear*, **restorant/restaurant*).

The spelling challenges involving consonants that are absent from Arabic, along with their cognate pairs, align with prior research that highlighted frequent confusion between /b/ and /p/, as well as between /f/ and /v/, among Arabic L1 learners (Allaith & Joshi, 2011), and research that reported that Arabic L1 learners tend to use graphemes that represent /k/ and /dʒ/ to spell the sounds /g/ and /tʃ/, respectively (Allaith & Joshi, 2013). Additional patterns include the substitution of /ʃ/ with /tʃ/ and confusion between /ʒ/ and /ʃ/. Notably, /tʃ/ is absent in Standard Arabic but present in Spoken Arabic, while /ʒ/ is absent from Arabic altogether. These patterns reflect specific difficulties with phonemes missing in learners' L1, causing overgeneralization of English spelling rules. This negative cross-linguistic transfer supports the Linguistic Affiliation Hypothesis (Russak & Saiegh-Haddad, 2011). Comparable spelling error examples include Afrikaans /f/-/v/ **vuur/fire* (De Sousa et al., 2011), Chinese /θ/-/s/ **serd/third* (Bear et al., 2018), French /ð/-/d/ **dey/they* (Morris, 2001), Greek /b/-/p/ **jumbed/jumped* (Kuloheri, 2014), Japanese /l/-/r/ **negrect/neglect* (Gunion, 2012), and Thai /θ/-/t/ **someting/something* (Naruemon, 2012).

However, vowel errors appear to be less connected to the participants' L1 and more influenced by the developmental aspects of learning the complex English orthography system. This is evidenced by similar errors documented in the writings of English L1 speakers (Bahr et al., 2012) and English L2 learners from diverse backgrounds, such as Afrikaans **huis/house* (De Sousa et al., 2011), Chinese **gam/gum* (Bear et al., 2018), French **mather/mother* (Morris, 2001), Greek **grups/groups* (Kuloheri, 2014), Japanese **pronaunceasion/pronunciation* (Gunion, 2012), and Thai **strenge/strange* (Naruemon, 2012).

It is worth noting that the phonological errors compiled here do not indicate frequent vowel omissions. Most errors show awareness of the need to include vowels, even if they are misspelled. Thus, while Arabic L1 speakers may struggle with vowel processing (Hayes-Harb, 2006; Martin, 2017; Ryan & Meara, 1991), this weakness does not necessarily present itself in the form of omitting vowels from English words. This conclusion supports Deacon's (2017) findings on orthographic transfer of vowels.

Graphemic-orthographic errors

Graphemic-orthographic errors pertain to words that require orthographic knowledge beyond basic letter-sound associations. These challenges reflect the complexity of the English writing system, a complexity that Arabic speakers typically do not encounter in Arabic. The classification used in the appendix table separates errors involving consonants from those involving vowels.

Errors in *c/s* choices often reflect a lack of awareness of word origin. For instance, spelling /s/ as *c* in words like **sentense/sentence*, **sity/city*, **reduse/reduce*, **experiense/experience,* and **conserns/concerns* indicates unfamiliarity with the Latin and Old French roots of these words. Similarly, while /ʃ/ is spelled as *sh* in Anglo-Saxon words, it appears as *ch* in French-origin words and *ti*, *si*, or *ci* in Latin-driven words (Joshi et al., 2008). This variation helps explain errors like **permition/permission*, **pachent/patient*, **controvertial/controversial*, **crusial/crucial*, **preftionally/professionally*, and **fation/fashion*. Other examples, such as **elefant/elephant* or **sychology/psychology*, require knowledge that /s/ and /f/ are reliably spelled as *ps* and *ph* in Greek-origin words (Joshi et al., 2008). While these misspellings reflect gaps in morphological knowledge and word origin, they also show that learners are using phonetically plausible English graphemes for the intended sounds. In this sense, even unconventional spellings demonstrate some level of orthographic understanding.

Some of the graphemic-orthographic errors also reflect limited knowledge of English syllable patterns and word parts. English spelling is governed by several generalizations. The floss rule dictates that in one-syllable words with a short vowel ending in *f*, *l*, *s*, or *z*, the final consonant should be doubled (Henry, 2003). Errors like **wal/wall* reflect a lack of knowledge of this rule, while errors like **godd/god* show its overgeneralization. Moreover, the rabbit rule holds that the medial consonant in two-syllable words should be doubled if the first vowel is short (Carreker, 2011). Errors like **polute/pollute*, **hopies/hobbies,* and **sumer/summer* indicate a lack of knowledge of this rule, while **imottion/emotion* and **ellectronic/electronic* suggest overgeneralization. Furthermore, the doubling rule requires doubling the final consonant in one-syllable words with short vowels before adding a suffix (Henry, 2003). Errors like **stoped/stopped* and **runing/running* reflect gaps in this knowledge, while **slowwing/slowing* and **bookking/booking* show overgeneralization. Additionally, the dropping rule requires omitting the final *-e* before a suffix that begins with a vowel, and this rule explains errors like **takeing/taking* and **compareing/comparing*. Similarly, the changing rule states that the final *y* should be changed to *i* before suffixes, unless the suffix begins with *i* or is preceded by a vowel (Henry, 2003). Errors like **payed/paid* and **trys/tries* reflect a lack of knowledge of this rule. Other frequent errors include dropping *l* before adding *-ly* (e.g., **realy/really*, **mentaly/*

mentally), possibly because the letter is phonetically redundant or due to inaccurate understanding of the dropping rule. Many graphemic-orthographic errors require awareness of consistent, albeit complex, spelling generalizations. For example, selecting the correct grapheme for /k/ or /ʤ/ depends on the letter's position in a word and the following vowel. Using the changing or doubling rules also requires understanding of syllable junctures. In contrast, certain choices, such as when to use *c* versus *s* for /s/, depend less on rules and more on etymological knowledge.

Vowel-related graphemic-orthographic errors often involve unconventional yet phonetically plausible spellings. English vowels are complex: some sounds have frequent, reliable graphemes, while others can be spelled in multiple or infrequent ways. For instance, /ē/ is spelled differently in *feet*, *athletes*, *equal*, *three*, *penny*, *beach*, *ceiling*, *valley*, *ski*, *priest*, and *petite* (Carreker, 2011). Examining the vowel errors reported for Arabic L1 learners shows patterns rather than randomness. Errors like **speek/speak*, **speach/speech*, **geless/jealous*, **frend/friend*, and **duble/double* involve phonetically plausible but unconventional grapheme choices. These errors suggest that learners are applying known sound-letter associations without accounting for English irregularities. A less common but noteworthy pattern involves using letter names to represent sounds (e.g., **fel/feel*, **pepole/people*), a developmental trait often seen in beginning spellers (Bear et al., 2015). However, these errors likely stem from the same orthographic complexity rather than the developmental stage alone.

Other errors reflect misunderstanding of the silent *-e* rule. Omissions (e.g., **lif/life*, **invit/invite,* **mistaks/mistakes*) or overgeneralizations (e.g., **begane/began*, **roome/room*, **kinde/kind*) indicate confusion about how an *-e* signals a long vowel. Additional errors, like **monye/money* and **abuot/about,* show transposition of graphemes, indicating a lack of solid understanding of English graphemes, while other transposition errors, like **cheif/chief* and **langauge/language* likely reflect the multiple alternative spellings of English vowels.

Morphological-semantic errors

Morphological-semantic errors, like graphemic-orthographic ones, require knowledge that goes beyond basic letter-sound associations. Homophones must be memorized, as they are not governed by specific rules. Thus, errors like **there/their*, **brake/break*, **right/write*, **week/weak*, and **lose/loose* reflect a lack of orthographic knowledge, rather than cross-linguistic transfer from L1 to L2.

Other errors involve nearly similar-sounding words, such as **will/well*, **beard/bird*, **hall/whole*, and **tin/ten*. These likely arise from pronunciation errors, which then affect phoneme-to-grapheme mapping. Additionally, accurate spelling of words like *health*, *knowledge*, and *business* requires understanding how root words are preserved after derivation (Joshi et al., 2008). Errors such as **helth*, **knoldg*, and **busness* can be attributed to a lack of this morphological awareness.

Developmental versus cross-linguistic errors

By synthesizing the findings of spelling error studies based on writing samples from Arabic L1 speakers with previous research on spelling errors among learners from other backgrounds, it becomes crucial to distinguish between developmental spelling errors common to all learners and those specific to learners' L1. On the one hand, substitution errors that arise from the absence of certain consonants in Arabic are specific to Arabic L1, causing confusion between cognate phoneme pairs. Errors with spelling /b/-/p/, /f/-/v/, /k/-/g/, and /dʒ/-/tʃ/ contrast with errors produced by Spanish speakers when misspelling /v/ as *b* and /θ/ as *d*, due to the absence of /v/ and /θ/ from their L1 (Fashola et al., 1996; Hevia-Tuero et al., 2023; Linder et al., 2022; Sun-Alperin & Wang, 2008). The phoneme errors among Arabic speakers related to sounds not present in their L1 also differ from the confusion of /l/ and /r/ among Japanese L1 speakers, due to the absence of these sounds in their L1 (Cook, 1997); as well as the difficulties Cantonese L1 speakers face when spelling /θ/, which is absent from their L1 (Wang & Geva, 2003a). The reoccurring consonant-confusion spelling errors among Arabic L1 speakers have not been reported among English learners from other L1 backgrounds, and the errors reported among other learners do not appear among Arabic speakers. In sum, each group of learners exhibits different spelling errors influenced by the absence of specific phonemes from their L1.

On the other hand, graphemic-orthographic and morphological-semantic errors appear developmental in nature and not unique to Arabic L1 speakers. Similar errors have been reported across other populations, including errors with vowels, homophones, and spelling generalizations, such as Afrikaans **docter/doctor* (De Sousa et al., 2011); Chinese **hop/hope* (Bear et al., 2018); French **now/know* (Morris, 2001); Greek **hobies/hobbies* (Kuloheri, 2014); Japanese **habbit/habit* (Gunion, 2012); Spanish **ofice/office*, **preffers/prefers*, **their/there* (Hevia-Tuero et al., 2023); and Thai **untill/until* (Naruemon, 2012). Similar errors also appear among English L1 speakers (Bahr et al., 2012; Bourassa & Treiman, 2003).

Developmentally, the spelling errors suggest a wide range of proficiency levels, although all participants were university students. Based on Bear et al.'s (2015) framework, Arabic L1 learners showed evidence of errors associated with every stage of spelling development. Early emergent stage traits appeared in errors like **fel/feel* and **flor/floor,* which reflect reliance on letter names. Errors like **rid/red* and **lave/love* are typical of learners in the middle of the letter-name alphabetic stage, while **lif/life* and **there/their* align with the within-word patterns stage. Errors like **stoped/stopped* and **takeing/taking* show incomplete mastery of syllable-juncture rules, aligning with the syllables and affixes stage. Errors like **sycholojy/psychology* and **permition/permission*, tied to root word knowledge confusion, indicate traits of the derivational relations stage. Nevertheless, given the descriptive nature of the data and lack of longitudinal analyses, it is unfeasible to conclude whether Arabic L1 speakers mirror English L1 speakers through these five stages or follow a unique developmental path.

Although participants in all studies were adults, some errors are barely present at this level while others persist. The compiled findings show only a few reported instances of omitting non-silent letters and using letter names to spell sounds. This suggests that most participants have progressed beyond the letter-name alphabetic stage, where spelling relies heavily on letter names and letter-sound associations (Bear et al., 2015). In fact, the findings indicate

that, despite the transparent nature of Arabic orthography, Arabic L1 speakers show implied knowledge of the complex English orthographic system and awareness of the need to go beyond letter-sound associations. This is shown by overgeneralizing spelling patterns, such as errors with the floss rule, the rabbit rule, and the silent *-e* rule, all of which are associated with the within-word patterns stage; errors related to syllable junctures like the doubling, dropping, and changing rules reflecting the syllables and affixes stage; and errors relevant to root words and origins related to the derivational relations stage (Bear et al., 2015). Participants within and across studies were likely at different spelling developmental stages, and these stages were reflected in their errors. Without targeted instruction, progress across spelling stages may not occur or may be slow. Errors influenced by Arabic, including pronunciation and the absence of some English phonemes from Arabic, also persist at the university level.

In sum, phonological errors involving consonants absent from Arabic among Arabic L1 speakers stem from negative cross-linguistic transfer from Arabic to English. However, data does not suggest widespread vowel omission errors due to unvowelized Arabic influence. Moreover, phonological errors with vowels do not appear to be unique to Arabic L1 speakers and likely result from pronunciation inaccuracies and unstable grapheme-phoneme mapping. Graphemic-orthographic and morphological-semantic errors also do not appear to be unique to Arabic L1 speakers and likely arise from the complexity of the English orthography. Moreover, it is reasonable to assume many errors reflect participants' proficiency levels, paralleling beginning English writers who initially spell phonetically but gradually incorporate more complex orthographic patterns as they improve.

Comparing spelling performance of Arabic L1 speakers with other L1 groups

Several studies have compared the English spelling performance of Arabic L1 speakers to that of English L1 speakers and speakers from other L1 backgrounds. Table 2 presents the studies and their key findings.

Table 2

Summary of studies comparing English spelling performance of Arabic L1 speakers and speakers from other L1 backgrounds

Study	Arabic L1 Speakers' Background	*N*	Comparison Group	*N*	Measure	Key Findings
Studies on English Phonemes Absent from Arabic						
Allaith & Joshi (2011)	Grades 4 & 6	70 & 87	English L1 speakers matched for reading level (Grades 2 & 4)	40 & 47	Monosyllabic words targeting cognate pairs, focusing on /b/-/p/, /f/-/v/, and /d/-/t/	Arabic L1 speakers spelled /p/ as *b* and /v/ as *f*, and also spelled /b/ as *p* and /f/ as *v*, due to the absence of /p/ and /v/ from Arabic.
Allaith & Joshi (2013)	Grades 4 & 6	70 & 87	English L1 speakers matched for reading level (Grades 2 & 4)	40 & 47	Monosyllabic words targeting cognate pairs, focusing on /k/-/g/, /dʒ/-/tʃ/, and /s/-/z/	Arabic L1 speakers spelled /g/ using /k/ graphemes and /tʃ/ using /dʒ/ graphemes, but not the other way around, because /g/ and /tʃ/ exist in Spoken Arabic but not Standard Arabic.

Study	Arabic L1 Speakers' Background	N	Comparison Group	N	Measure	Key Findings
Studies on General Spelling Skills						
Abu-Rabia & Siegel (2002)	Ages 9-14 (typical and struggling readers)	56	English L1 peers (typical and struggling readers)	65	WRAT-R (Jastak & Wilkinson, 1984*)	Positive cross-linguistic transfer for Arabic L1 struggling readers.
Fender (2008)	Adults	16	Chinese, Japanese, and Korean L1 speakers	21	Mono- and multisyllabic words targeting within-word, syllable-juncture, and derivational patterns	Arabic L1 speakers performed more poorly on all three patterns.
Russak (2019)	Grade 4	168	Grade 4 Hebrew L1 speakers	190	Real words	Arabic L1 speakers outperformed Hebrew peers.
Russak (2020a)	Grade 4	168	Grade 4 Hebrew L1 speakers	190	Regular and irregular words	Similar performance on irregular words; Arabic L1 speakers outperformed Hebrew peers in spelling regular words.
Schwartz et al. (2016)	Grade 5	30	Grade 5 Hebrew L1 speakers	45	Pseudowords targeting vowels, consonant digraphs, and the letter *p*.	Arabic L1 speakers outperformed Hebrew peers on all patterns except spelling *p*.

**As cited by the authors of the study.*

Studies on English phonemes absent from Arabic

Two studies examined the spelling performance of Arabic L1 speakers on English phonemes not found in Arabic and their cognate pairs, comparing them to English L1 speakers. Allaith and Joshi (2011) focused on the phonemes /p/ and /v/, absent from Arabic; their cognate pairs /b/ and /f/, which are shared by both languages; and the control pair /d/ and /t/, also present in both languages. Participants received two error scores: one for confusing cognate pairs and one for other errors. Results indicated that Arabic L1 speakers performed similarly to the English L1 speakers on spelling /t/ and /d/, and on errors not involving cognate pairs across all phonemes. However, Arabic L1 speakers made more errors confusing /b/ with /p/ and /f/ with /v/. Effect sizes for Grades 4 and 6 were /p/ = 0.77 and 0.74, /b/ = 0.57 and 0.62, /v/ = 0.41 and 0.39, and /f/ = 0.21 and 0.30. These results imply that a phoneme's absence in L1 can impede the spelling of that sound in L2 and its cognate pair.

In a follow-up study, Allaith and Joshi (2013) investigated the spelling of English phonemes present in Spoken Arabic but absent from Standard Arabic due to diglossia. Target phonemes were /g/ and /tʃ/ (present in Spoken Arabic but not Standard Arabic), their cognate pairs /k/ and /dʒ/ (present in both Arabic and English), and the control pair /s/ and /z/. Non-cognate errors were comparable across groups except for /tʃ/, where Arabic L1 speakers made more errors. Arabic L1 speakers made more cognate-pair errors on /g/ and /tʃ/ than English L1 speakers (ES = 0.43 and 0.43 for /g/, and 0.44 and 0.47 for /tʃ/ for Grades 4 and 6). Cognate-pair errors on /k/, /dʒ/, /s/, and /z/ were comparable across both groups. These L1-related errors in both studies persisted into Grades 8 and 10 with little improvement.

Together, these two studies show that Arabic phonology can both support and hinder English spelling. When both cognate phoneme pairs are present in Arabic and English, Arabic L1 speakers demonstrate strong perception of voicing and benefit from positive transfer. When one phoneme is absent from Arabic and its cognate pair is present, overcompensation often leads to confusion between the cognate pairs. When a phoneme exists only in Spoken Arabic but not in Standard Arabic, and its pair exists in both Standard Arabic and English, errors are confined to the phoneme absent from Standard Arabic. This implies that phonological awareness alone is insufficient and that letter-sound knowledge is also needed to support accurate spelling transfer. However, neither study examined participants' pronunciation, so it remains unclear whether these errors reflect mispronunciation or difficulty forming graphemic representations. These studies also shed light on how such errors are related to proficiency level. In Allaith and Joshi (2011), errors in spelling /p/ as *b* slightly decreased between Grades 4 and 6 but showed no significant change from Grades 6 to 10. Errors in spelling /v/ as *f* followed a similar pattern, with only minor improvement across grades. In contrast, confusion between /b/ and /f/ and their cognate pairs showed no decline from Grades 4 to 10. In Allaith and Joshi (2013), errors spelling /g/ with its cognate pair decreased significantly between Grades 8 and 10, and Grade 10 participants made fewer cognate-pair errors on /tʃ/ than Grade 4 students. When considered alongside similar errors found in adult university students' writing (as discussed in the previous section), these findings suggest that while such errors may decrease with increased proficiency, they often persist over time.

Studies on general spelling skills

One study compared Arabic L1 speakers with English L1 speakers. Abu-Rabia and Siegel (2002) focused on spelling performance among both typically achieving and struggling readers. Despite comparable scores on reading, language, and memory measures, struggling Arabic L1 readers outperformed struggling English L1 readers in spelling. The mean spelling score for the struggling Arabic L1 readers was 20.7 (*SD* = 6.4), while it was 10.5 (*SD* = 6.2) for the English L1 speakers. Typically achieving readers showed similar spelling scores (Arabic L1: *M* = 42.1, *SD* = 5.5; English L1: *M* = 44.2, *SD* = 8.5). The authors concluded that the difference suggests positive cross-linguistic transfer from Arabic's more transparent script to English's more opaque one, indicating that bilingualism benefits struggling readers' spelling achievement.

Studies comparing Arabic L1 speakers with other L1 groups mostly involved Hebrew L1 speakers and suggest added benefits for Arabic L1 speakers. Schwartz et al. (2016) compared Arabic and Hebrew L1 children on spelling English vowels, the letter *p*, and consonant digraphs. Except for the letter *p*, Arabic L1 speakers (*M* = 43.3, *SD* = 13.08) outperformed Hebrew L1 speakers (*M* = 30.9, *SD* = 19.96, η^2 = 0.11). The authors explained their findings via the linguistic and orthographic proximity hypothesis, linking the advantage to similarities between Arabic and English. Similarly, Russak (2019) found that Arabic L1 speakers (*M* = 34.37, *SD* = 20) scored higher than Hebrew L1 speakers (*M* = 30.01, *SD* = 9.22, ES = 0.22) in spelling real English words. Russak (2020a) also reported Arabic L1 speakers (*M* = 36.30) outscored Hebrew L1 speakers (*M* = 31.71) on spelling regular English words, though both groups performed similarly on spelling irregular words (Arabic L1: *M* = 26.91, Hebrew L1: *M* = 23.22). Russak attributed better performance on regular words to reliance on phonological strategies, expected at early

stages of learning English, as orthographic considerations come later. Differences between groups were also linked to Arabic L1 speakers' trilingualism (including Hebrew) versus the bilingualism of Hebrew L1 speakers.

In contrast, Fender (2008) found Arabic L1 speakers struggled more with English spelling compared to Chinese, Japanese, and Korean L1 speakers. His spelling test included within-word patterns (short, long, and complex vowels), syllable-juncture patterns (consonant doubling and open/closed syllables), and derivational patterns. While listening comprehension was comparable, Arabic L1 speakers scored lower in all spelling categories. Scores were lowest for derivational patterns, followed by the syllable-juncture patterns, and then the within-word patterns. The mean scores for the Arabic speakers were 8.38 (*SD* = 2.85), 10 (*SD* = 3.27), and 18.19 (*SD* = 2.8) consecutively, while the mean scores for the non-Arabic speakers were 14.57 (*SD* = 3.06), 14.52 (*SD* = 2.23), and 20.71 (*SD* = 1.31) consecutively. Reading comprehension and spelling were moderately correlated for non-Arabic speakers ($r = 0.57$, $p < .01$) but not statistically significant for the Arabic L1 speakers ($r = -0.15$, $p > .05$). This finding contradicts the well-established reading-writing link. The author speculated that the difference might be due to Arabic's influence on English learning, with Arabic speakers relying heavily on consonant structures for recognizing English words, or due to less English exposure among Arabic L1 participants. The small sample size means further research is needed.

Taken together, the findings across the various studies raise some questions. Russak (2019, 2020a) and Schwartz et al. (2016) showed stronger cross-linguistic transfer between Arabic and English for Arabic L1 children compared to Hebrew L1 children. Both languages are Semitic and use similar orthographies. Russak credited the trilingualism of Arabic participants as an added benefit. This raises the question of whether Arabic L1 speakers would perform similarly to Hebrew L1 speakers if both groups were bilingual and only spoke English in addition to their L1, or if both were trilingual. Abu-Rabia and Siegel (2002) found cross-linguistic benefits only in struggling readers, not typically developing ones, raising the question of how struggling Arabic L1 readers compare to struggling readers of other backgrounds. Furthermore, since the measures differed across studies, could the relationship between Arabic and English spelling vary depending on which spelling patterns are tested? Fender's (2008) adult-focused study, which suggested Arabic L1 speakers perform worse than Chinese, Japanese, and Korean L1 speakers, contrasts with the child-focused studies suggesting an Arabic advantage over Hebrew. Does Arabic facilitate spelling transfer more than Hebrew but less than East Asian languages? Or does age/developmental level play a role? Would a larger-scale study considering language proficiency replicate these findings? These questions open wide avenues for future research, including comparing Arabic L1 speakers with English L1 speakers alongside English L2 speakers from Semitic and non-Semitic, transparent and opaque L1 backgrounds, while accounting for bilingualism and trilingualism. Research should also investigate subskills contributing to spelling, which may differ across language learners (cf. Russak, 2020b).

Although the data do not permit conclusions regarding differences in spelling errors based on English proficiency, it is noteworthy that Arabic L1 children in Grade 5 and below demonstrated spelling advantages compared to peers from other backgrounds, whereas Fender's (2008) study focused on adults indicated that Arabic L1 speakers had lower spelling skills. This suggests

that Arabic's transparent script might help early English spelling development but could hinder more advanced Arabic L1 English learners compared to those from other language backgrounds. Future research should compare the spelling skills of Arabic L1 children and adults with those of other language groups to better understand their unique challenges and strengths in learning English spelling.

Effective spelling interventions for Arabic L1 speakers

Few studies have explored interventions aimed at improving English spelling among Arabic L1 speakers. Of those available, two focused on teaching English vowel pronunciation and letter-sound mapping, while one targeted within-word and syllable-juncture patterns. Table 3 summarizes these studies.

Table 3

Summary of English spelling interventions for Arabic L1 speakers

Study	Participants' Background	*N*	Interventions	Effectiveness
Allaith (2023)	University students	91	Word study of within-word patterns (/k/, floss rule) and syllable-juncture patterns (doubling rule, dropping rule)	Positive
Ishizaki (2018)	University students	20	Pronunciation and letter-sound mapping of vowels	Positive
Khan (2013)	University students	15	Pronunciation and letter-sound mapping of vowels	Positive

Ishizaki (2018) and Khan (2013) implemented interventions for university students focused on English vowels through pronunciation and letter-sound mapping tasks. Ishizaki introduced grapheme-phoneme generalizations and engaged participants in sorting, syllabification, phoneme production, identification, dictation, and both listening to and reading aloud target words. The intervention spanned 14 one-hour sessions, held three times a week, over two months, with all target phonemes covered in each session. Khan delivered ten hours of instruction across two weeks, during which students heard, pronounced, and read vowel-containing words. They also counted vowels in words, copied them, and identified vowels in given words. The words increased in complexity, with vowels introduced in isolation initially and later combined.

Both studies reported improvements in spelling the target vowels. In Ishizaki's (2018) study, mean scores increased from 30.67 to 43.03 (d = 1.29). Khan (2013) reported a drop in vowel errors from 161 (by 7-19 participants per word) to just 13 (by 0-3 participants). Both noted vowel digraphs and vowels in multisyllabic words were especially difficult. However, results should be interpreted with caution. Ishizaki used the same words in the pre- and post-tests, making it unclear if gains were due to instruction or exposure. Khan's test design lacked equivalency: the pre-test included familiar words and Arabic names in English letters, while the post-test drew from education and travel registries. Neither study distinguished pronunciation-related errors from orthographic errors, and neither clarified whether more complex patterns (e.g., *laughter* and *flight*) were addressed differently from simpler letter-to-sound patterns (e.g., *stop* and *travel*).

Allaith (2023) examined two within-word patterns (spelling /k/ and the floss rule) and two syllable-juncture patterns (the dropping rule and the doubling rule). The intervention used a word-study approach: participants sorted words to deduce spelling generalizations, verified them in textbooks, brainstormed additional examples, and used them in sentences. One group followed this approach alone, while another additionally completed reading comprehension tasks with embedded target patterns. Both groups showed comparable, statistically significant gains, indicating no added benefit from the comprehension component. Effect sizes varied by pattern (/k/: $d = 0.53$, floss rule: $d = 1.26$, dropping rule: $d = 0.39$, doubling rule: $d = 0.67$). The study concluded that difficulty varied across English spelling generalizations, and learning some generalizations is easier than others.

None of the interventions included control groups of English L1 or non-Arabic L2 speakers. Still, they collectively demonstrate that explicit spelling instruction benefits Arabic L1 learners, as has also been shown for English L1 learners (cf. Graham & Santangelo, 2014).

Summary of findings

The accumulated literature on Arabic L1 speakers' ability to spell English words demonstrates reoccurring errors with both consonants and vowels. Some of these errors reflect cross-linguistic transfer from L1 to L2, while others suggest difficulty with the complex English orthographic system. Most of the available studies are descriptive in nature and rely on written samples. These studies did not include control groups (English L1 speakers or non-Arabic English L2 speakers), nor did they employ inferential statistics to support generalization or inclusion in meta-analyses.

Nevertheless, they collectively identify patterns of phonological errors, particularly when spelling phonemes that are absent from Arabic and their cognate pairs. They also highlight graphemic-orthographic errors that involve multi-layered English patterns beyond letter-sound correspondence, and morphological-semantic errors related to homophones and nearly similar words. The literature does not suggest that vowel omission is a dominant type of error among Arabic L1 speakers when spelling in English.

Several studies compared Arabic L1 learners to English L1 learners or English L2 learners from other backgrounds. These studies confirm the difficulty Arabic speakers have with spelling phonemes that are absent from Arabic and their cognate pairs. They also show that the presence of phonemes in Spoken Arabic but not Standard Arabic supports the transfer of cognate pairs that have a written form in Standard Arabic, but not their pairs that exist only in Spoken Arabic and lack a written form. Additionally, Arabic L1 children outperformed English L1 learners in spelling among struggling readers and generally performed better than Hebrew L1 learners in spelling English words, although Arabic L1 adults did not perform as well as Cantonese, Japanese, or Korean L1 learners. The reasons behind these cross-linguistic differences merit further research.

In sum, the difficulties with phonemes that are absent from Arabic and their cognate pairs are likely tied to L1 influence. In contrast, other spelling errors appear more universal among

language learners and resemble the developmental errors seen in English L1 learners' writings. These latter difficulties are more likely attributed to the inherent complexity of the English orthography rather than negative transfer from Arabic L1. Although limited in number, existing intervention studies indicate that explicit instruction in pronunciation, letter-sound mapping, and within-word and syllable-juncture patterns yields positive outcomes.

Instructional recommendations

Given these findings, it is evident that English spelling proficiency cannot be expected by exposure to print alone. Arabic L1 learners require a shift from reliance on teaching spelling through thematic word lists and rote memorization toward comprehensive and structured spelling instruction that considers the developmental stages of spelling acquisition. Recommended strategies include integrating L1 and L2 spelling instruction (Allaith & Joshi, 2013), implementing explicit word-study approaches (Allaith, 2023), and teaching letter-sound correspondence alongside pronunciation (Ishizaki, 2018; Khan, 2013). It is also important to score spelling tasks qualitatively to better inform instruction.

For challenges specific to Arabic L1 learners, teachers should provide phonemic awareness activities involving minimal pairs (e.g., *pill/bill*, *pack/back*, *fast/vast*, *fan/van*) that target English phonemes that are absent from Arabic and their cognate pairs. These can include picture sorts, listening discrimination and matching tasks, and blending and segmenting routines. Pronunciation-focused activities should reinforce distinctions between confusing sound pairs, and spelling practice should include both real words and non-words that emphasize these contrasts.

To address difficulties tied to the complexity of the English orthography, teachers should begin with a diagnostic spelling assessment to identify each learners' developmental stage. Instruction can then be aligned to those stages. For instance, students can be taught spelling patterns using groups of words that share the same phoneme sound and spelling pattern at the same time. Once these are mastered, students can be guided to contrast them with groups of words that have the same phoneme sound but different spelling patterns.

Instruction should also target within-word patterns (e.g., in the initial position, /k/ is spelled as *k* before *e, i,* or *y,* and as *c* before *a, o, u,* and consonants) and syllable-juncture rules (e.g., the floss, doubling, and dropping rules). Morphological knowledge and root word instruction are also integral parts of spelling instruction (Carreker, 2011) because English is a morphophonemic language, meaning that spelling patterns reflect both the phonological and morphological structures of words. Furthermore, it is important that students explore the spelling layers of English and how spelling patterns are influenced by word origin. Bear et al. (2015) offer a thorough framework for teaching these elements at various developmental levels, including word lists and strategies aligned with each developmental stage.

Future directions

This review identifies several areas that require further research. First, studies should adopt a categorization system for spelling errors that reflects spelling developmental stages. This

would allow for better synthesis across studies and support quantifiable conclusions. Moreover, while written samples are useful for capturing organic spelling patterns and errors, they are limited by the vocabulary used in a given text. Accordingly, future studies should use systematic quantitative methods to better measure the frequency of each error type while considering L1 influence. Reporting effect sizes would also support the inclusion of studies in meta-analyses and generalizability to populations.

Second, longitudinal research is needed to track the development of English spelling among Arabic L1 learners. This would help establish a developmental framework specific to this population and determine whether certain errors diminish over time. This effort can be modeled after studies that have previously tackled this matter with different language backgrounds (e.g., Allaith & Joshi, 2011, 2013; Linder et al., 2022; Russak & Kahn-Horwitz, 2015). Comparative data would allow researchers to distinguish universal challenges from those that are language-specific, ultimately informing more targeted instruction.

Third, future studies should investigate whether Arabic L1 learners rely primarily on phonology, orthography, or morphology in English spelling. Hevia-Tuero et al. (2023) provide a model for this kind of work based on Spanish L1 learners. This effort should be examined longitudinally to determine whether reliance on phonology declines with improved proficiency or remains dominant, as in the case of Spanish speakers. Eye-tracking research could also shed light on whether Arabic speakers rely more on phonological or visual cues during spelling. Understanding these cognitive strategies is key to better understanding the challenges faced by Arabic L1 speakers in learning English and for designing effective instruction.

Fourth, the current body of intervention research remains limited both in scope and number. Existing studies focus on pronunciation, letter-sound mapping, and basic spelling generalizations. Future research should explore interventions that address enhancing phonological awareness, systematic approaches to teaching multiple spelling patterns for the same vowel and consonant sounds, strategies for teaching root words and morphemes, and interventions focused on teaching the different layers of English, including word origins.

Finally, future studies must include more representative samples of the Arabic-speaking population. Current spelling studies largely focus on university students or compare Arabic-speaking children with Hebrew-speaking peers, with limited research comparing Arabic speakers to learners from other language backgrounds across different age groups. Moreover, there is a need to account for learning differences such as dyslexia and dysgraphia, which are rarely addressed in L2 spelling research. Broader and more inclusive research will lead to more accurate findings, which in turn can inform more equitable instructional practices and better educational decisions.

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Appendix

Qualitative categorization of common errors in English writing by Arabic L1 speakers

Phonological Errors	Study	Misspelling Examples
Consonants		
Omission (non-silent phonemes)	Albesher (2018)	*electroni_/electronic, *envir_ment/environment, *go_rment/government
	Alenazi et al. (2021)	*midd_e/middle
	Deacon (2017)	*hear_/heart
	Ibrahim (1978)	*atti_ude/attitude, *supers_tion/superstition
Addition	Alenazi et al. (2021)	*habbite/ hobby
	Deacon (2017)	*driviting/driving, *prefefers/prefers, *toghothar/together
Transposition	Deacon (2017)	*starnge/strange, *ingore/ignore
	Ibrahim (1978)	*indicants/ incidents
Substitution (/b/-/p/)	Albesher (2018)	*jop/job, *barking/parking, *blay/play, *brobably/probably, *bain/pain, *bray/pray, *banda/panda, *blaza/plaza, *labtob/laptop, *combuter/computer
	Alenazi et al. (2021)	*hopies/hobbies, *hapit/habit, *stambs/stamps
	Alsher (2021)	*numpers/numbers, *minibulate/manipulate
	Deacon (2017)	*plak/black
	El-Hibir & Al-Taha (1992)	*apsent/absent, *hapits/habits, *barty/party, *pubil/pupil, *blay/play, *groubs/groups
	Haggan (1991)	*distipution/distribution, *piography/biography, *pridge/bridge, *prief/brief
	Hamed (2008)	*jop/job, *rememper/remember, *proplems/problems
	Ibrahim (1978)	*distripution/distribution, *clup/club, *hapit/habit, *hoppy/hobby, *pit/bit, *compination/combination, *blaying/playing, *bicture/picture, *Jaban/Japan, *bombous/pompous
Substitution (/f/-/v/)	Albesher (2018)	*telefision/television, *wifes/wives
	Alenazi et al. (2021)	*facation/vacation
	El-Hibir & Al-Taha (1992)	*fery/very, *profence/province
	Haggan (1991)	*safed/saved
	Ibrahim (1978)	*savety/safety
Substitution (/ʒ/-/tʃ/)	Albesher (2018)	*conclution/conclusion, *decition/decision, *meajer/measure
	Aloglah (2018)	*conclution/conclusion
	Deacon (2017)	*televition/television
Substitution (tʃ/-/ʃ/)	Albesher (2018)	*sandwish/sandwich, *sheep/cheap
	Alsher (2021)	*shoke/choke
	Alenazi et al. (2021)	*asch/each
	Deacon (2017)	*mush/much
Substitution (other)	Albesher (2018)	*burjer/burger
	Alenazi et al. (2021)	*citicen/citizen
	Alsher (2021)	*michropon/microphone
	Ibrahim (1978)	*covernment/government

Phonological Errors	Study	Misspelling Examples
Vowels		
Omission (non-silent phonemes)	Alenazi et al. (2021)	*cooll_ct/collect
	Ibrahim (1978)	*compl_tely/completely
Addition	Albesher (2018)	*childeren/children, *moderen/modern, *faculity/faculty, *firest/first, *seconed/second, *pirocessed/processed, *pepol/people
	Alenazi et al. (2021)	*pepole/people
	El-Hibir & Al-Taha (1992)	*espeak/speak, *estart/start, *estop/stop, *sitriss/stress, *libarary/library
	Deacon (2017)	*reasones/reasons
	Ibrahim (1978)	*communisem/communism
Substitution	Albesher (2018)	*hilthy/healthy, *injoy/enjoy, *doktoor/doctor, *budjut/budget, *restorant/restaurant, *defination/definition, *famos/famous, *genatic/genetic, *polotion/pollution, *impect/impact, *ferst/first, *treaditional/traditional, *toogether/together, *discunt/discount, *rason/reason, *belive/believe, *touition/tuition
	Alenazi et al. (2021)	*coollct/collect, *mast/must, *geun/gain, *asch/each, *pirson/person, *warking/working, *huoman/human, *midacally/medically, *tickeet/ticket, *habbite/hobby, *navre/never, *expirians/experience, *xet/exit
	Aloglah (2018)	*neocliar/nuclear
	Alsher (2021)	*exusted/exhausted
	Deacon (2017)	*eag/egg, *toghothar/together, *imottion/emotion
	El-Hibir & Al-Taha (1992)	*rid/red, *git/get, *kipt/kept, *frant/front, *lave/love, *abaut/about, *brather/brother, *mather/mother, *profence/providence, *sitriss/stress
	Haggan (1991)	*chose/choose, *cafiteria/cafeteria, *incloude/include, *resamblance/resemblance, *injoy/enjoy, *indix/index, *laggage/luggage, *apperead/appeared
	Hamed (2008)	*frind/friend
	Ibrahim (1978)	*languidge/language, *maney/money, *pronounciation/pronunciation, *scondl/scandal
Shwa	Albesher (2018)	*grammer/grammar, *envir_ment/environment, *freedum/freedom, *elegently/elegantly, *temp_racher/temperature, *varias/various, *diff_rent/different
	Alenazi et al. (2021)	*nav_re/never, *expirians/experience
	Aloglah (2018)	*unfamilier/unfamiliar
	Alsher (2021)	*minibulate/manipulate
	Deacon (2017)	*seviral/several, *preftionally/professionally, *geless/jealous, *inter_sted/interested
	El-Hibir & Al-Taha (1992)	*show_r/shower
	Haggan (1991)	*listining/listening, *intiristing/interesting
	Ibrahim (1978)	*putato/potato, *auther/author, *husbund/husband, *custums/customs, *mannar/manner, *scond_l/scandal, *indicants/incidents

Graphemic-Orthographic Errors	Study	Misspelling Examples
Consonants		
Grapheme Choice (c/s)	Albesher (2018)	*reduse/reduce, *prosecced/processed, *sentense/sentence, *choises/choices, *sience/science, *senter/center, *exersise/exercise
	Alenazi et al. (2021)	*expirians/experience
	Aloglah (2018)	*sentense/sentence
	Alsher (2021)	*fasebook/Facebook
	Deacon (2017)	*cources/courses
	El-Hibir & Al-Taha (1992)	*sity/city, *verc/verse, *nise/nice, *polise/police, *conserns/concerns, *univercity/university
	Ibrahim (1978)	*electrisity/electricity
Grapheme Choice (/tʃ/)	Albesher (2018) Alenazi et al. (2021)	*tempracher/temperature *beatch/beach
	Deacon (2017)	*teatchers/teachers
	El-Hibir & Al-Taha (1992)	*kichen/kitchen
Grapheme Choice (/ʃ/)	Albesher (2018)	*permition/permission
	Alenazi et al. (2021)	*pachent/patient
	Aloglah (2018)	*controvertial/controversial
	Alsher (2021)	*crusial/crucial
	Deacon (2017)	*preftionally/professionally
	Ibrahim (1978)	*fation/fashion
Grapheme Choice (/ʤ/)	Albesher (2018)	*budjut/budget, *nole_ge/knowledge, *vejetable/vegetable, *langwij/language, *sycholojy/psychology
	Deacon (2017)	*geless/jealous
	Haggan (1991)	*knoldg/knowledge
	Ibrahim (1978)	*languidge/language
Grapheme Choice (/k/)	Albesher (2018)	*doktoor/doctor, *karpet/carpet, *klimate/climate
	Deacon (2017)	*plak/black
	El-Hibir & Al-Taha (1992)	*bak/back, *kollege/college, *kome/come, *Arabik/Arabic
	Alsher (2021)	*michropon/microphone
Grapheme Choice (other)	Albesher (2018)	*wan/van, *nolege/knowledge, *elefant/elephant, *we_nsday/Wednesday, *sychologjy/psychology
	Alenazi et al. (2021)	*shou_d/should
	Alsher (2021)	*ex_usted/exhausted, *noice/noise
	Deacon (2017)	*gover_ment/government, *eag/egg
	El-Hibir & Al-Taha (1992)	*ans_er/answer, *_sychology/psychology
	Ibrahim (1978)	*gover_men/government
Floss Rule	Alsher (2021)	*godd/god
	Deacon (2017)	*midell/middle
	El-Hibir & Al-Taha (1992)	*wal/wall, *proces/process
	Ibrahim (1978)	*pilled/piled

Graphemic-Orthographic Errors	Study	Misspelling Examples
Rabbit Rule	Albesher (2018)	*milion/million, *gramar/grammar, *polotion/pollution
	Alenazi et al. (2021)	*hopies/hobbies
	Alsher (2021)	*polute/pollute, *ellectronic/electronic, *aggrement/agreement, *skyscrapper/skyscraper
	Deacon (2017)	*midell/middle, *imottion/emotion
	El-Hibir & Al-Taha (1992)	*ofic/office, *sumer/summer
Suffix (Doubling Rule)	Albesher (2018)	*traped/trapped, stoped/stopped
	Alenazi et al. (2021)	*stoped/stopped, *runing/running
	Aloglah (2018)	*swiming/swimming
	Deacon (2017)	*slowwing/slowing, *bookking/booking, *keepping/keeping
	Haggan (1991)	*swiming/swimming, *prefered/preferred
	Ibrahim (1978)	*occured/occurred, *transfered/transferred
Suffix (Dropping Rule)	Albesher (2018)	*takeing/taking
	Ibrahim (1978)	*closeing/closing, *compareing/comparing
Suffix (Changing Rule)	Albesher (2018)	*payed/paid, *familys/families, *happyer/happier, *applyed/applied, *flys/flies
	El-Hibir & Al-Taha (1992)	*countrys/countries, *universitys/universities, *trys/tries, *crys/cries
	Ibrahim (1978)	*trys/tries, *dayly/daily
Suffix (*-ly*)	Albesher (2018)	*real_y/really
	Alenazi et al. (2021)	*mental_y/mentally
	Deacon (2017)	*financial_y/financially, *real_y/really
	Haggan (1991)	*real_y/really
	Ibrahim (1978)	*initial_y/initially
Vowels		
Letter Names	Albesher (2018)	*coffe/coffee, *fel/feel, *spek/speak, *pepol/people
	Alenazi et al. (2021)	*pepole/people, *xet/exit
	Alsher (2021)	*felings/feelings, *aggrement/agreement
	Deacon (2017)	*butiful/beautiful
	El-Hibir & Al-Taha (1992)	*flor/floor, *urope/Europe
	Haggan (1991)	*apperead/appeared
Grapheme Representation (unconventional yet phonetically plausible)	Albesher (2018)	*speek/speak, *riligion/religion, *nauty/naughty, *langwij/language, *beutiful/beautiful, *enginier/engineer, *wether/weather, *marri_ge/marriage
	Alsher (2021)	*minite/minute
	Deacon (2017)	*geless/jealous, *leage/league
	El-Hibir & Al-Taha (1992)	*duble/double, *ev_ry/every
	Haggan (1991)	*corse/course, *dide/died, *helth/health, *knoldg/knowledge
	Hamed (2008)	*frend/friend, *beutiful/beautiful
	Ibrahim (1978)	*administrater/administrator, *biginner/beginner, *villigers/villagers, *idle/idol, *tought/taught, *chiep/cheap, *apostrophy/apostrophe, *fudal/feudal, *lownly/lonely, *sleaping/sleeping, *mony/money, *hight/height, *speach/speech, *faulse/false

Graphemic-Orthographic Errors	Study	Misspelling examples
Grapheme Representation (silent *-e*)	Albesher (2018)	*writ_/write
	Alenazi et al. (2021)	*lif_/life
	Aloglah (2018)	*playe/play, *begane/began
	Alsher (2021)	*invit_/invite, *michropon_/microphone
	Deacon (2017)	*peopl_/people, *mistak_s/mistakes, *sectore/sector, *companye/company
	El-Hibir & Al-Taha (1992)	*ofic_/office, *befor_/before, *larg_/large, *handl_/handle, *wer_/were, *verc_/verse, *kinde/kind, *finde/find, *roome/room
	Haggan (1991)	*playe/play, *begane/began, *houre/hour, *houres/hours
	Hamed (2008)	*whol_/whole, *befor_/before, *futur_/future
	Ibrahim (1978)	*nin_/nine
Transposition of Graphemes	Albesher (2018)	*chaep/cheap, *tow/two, *naer/near, *concieve/conceive, *recieve/receive
	Alenazi et al. (2021)	*monye/money, *abuot/about, *langauge/language, *thier/their
	Aloglah (2018)	*cheif/chief
	Deacon (2017)	*thier/their
	Haggan (1991)	*qoutation/quotation, *cheif/chief, *breif/brief
Morphological-Semantic Errors	**Study**	**Misspelling examples**
Homophones	Albesher (2018)	*there/their, *loose/lose, *brake/break, *mail/male, *right/write, *week/weak, *buy/bye, *by/buy, *for/four
	Alenazi et al. (2021)	*off/of
	Aloglah (2018)	*there/their, *their/there
	Haggan (1991)	*there/their, *their/there
	Ibrahim (1978)	*reed/read, *brake/break, *there/their, *their/there
Nearly Similar Words	Albesher (2018)	*will/well, *miss/mess, *bed/bad, *best/beast, *now/know, *wired/weird, *rise/rice
	Alenazi et al. (2021)	*beard/bird, *rude/road, *pace/peace
	Aloglah (2018)	*collages/colleges, *will/well
	El-Hibir & Al-Taha (1992)	*now/know, *rite/write, *care/car, *sit/set, *tin/ten, *bid/bed
	Ibrahim (1978)	*hall/whole, *coast/cost, *many/money
Preservation of Root Word	Albesher (2018)	*_no_ledge/knowledge
	Alsher (2021)	*bus_ness/business
	Haggan (1991)	*helth/health, *knoldg/knowledge