TOWARDS AN ADAPTIVE LANGUAGE MOOC: EXAMINING DIFFERENCES OF LANGUAGE ERROR PATTERNS ACROSS CULTURAL DOMAINS

Dr. Ozlem OZAN
ORCID: 0000-0002-4116-1551
Faculty of Communication
Yasar University
Izmir, TURKIYE

Dr. Yasin OZARSLAN
ORCID: 0000-0003-0831-6985
Faculty of Science & Letters
Yasar University
Izmir, TURKIYE

Dr. Sevgi CALISIR ZENCI
ORCID: 0000-0002-7942-5452
Faculty of Letters (Turkish Language and Literature)
Anadolu University
Eskisehir, TURKIYE

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ABSTRACT

This study analyzed linguistic errors as part of the Differentiated Distance Education of Turkish as a Foreign Language Project, which pursues the development of an adaptive MOOC for Turkish as a second language. Therefore, the Turkish CEFR (Common European Framework of Reference for Languages) A1-level writing exam papers of 177 learners were analyzed. Linguistic error analysis techniques were used. A Chi-square test of independence, a Kruskal-Wallis H test, and a Mann-Whitney U test were conducted to examine the data. The results show a relationship between error frequency and learner group (Arabic–Farsi, Turkic, Balkan, and Other). Similarly, the error density varied as a function of the learner group. There is also a relationship between error frequency and the language family of the learner's mother language. On the other hand, there is no significant difference in error density by language family. The number of languages the learner knows, has no significant effect on error frequency and density. The findings suggest that there are gender-based differences in error density among learners, but that these differences are not reflected in the frequency of errors. The topics for differentiation were identified based on the error distribution of learner groups. The topic that requires the most differentiation is noun phrases. The learner groups that need the most differentiation are the Arabic and Farsi Nations, while the Turkic Nations require the least differentiation.

Keywords: Turkish as a foreign language, error analysis, second language acquisition, adaptive language MOOC.

INTRODUCTION

In recent years, technology integration in education has sparked innovative methods in language learning, notably the development of the Massive Open Online Courses (MOOCs). MOOCs, accessible to a large global audience, offer opportunities to engage with personalized course materials, lectures, and assignments.

MOOCs typically provide standardized content for all learners, while variations include connective, extended, and adaptive MOOCs. Adaptive MOOCs employ adaptive technology to personalize the learning

experience. They use intelligent algorithms and data analytics to customize content and activities based on each learner's needs and abilities. Information regarding learners' preferences, interactions, and assignments is used to adapt course materials and learning paths and to provide personalized content recommendations, targeted feedback, and individualized pacing.

In adaptive language MOOCs, the focus is on learners' language proficiency data, which is gathered using machine learning techniques and computational linguistics, with a key component being error analysis. Error analysis helps identify sources of errors, evaluates performance, and categorizes errors. The data from error analysis provides valuable insights into learners' specific linguistic challenges and helps create robust datasets for designing and implementing adaptive language MOOCs with targeted assistance. However, the absence of tools such as error analysis and corrective feedback in language MOOC platforms is one of the main problems, as Sarre et al. (2021) mention.

This study examines linguistic error analysis in the initial phase of the Differentiated Distance Education of Turkish as a Foreign Language Project, aimed at developing an adaptive MOOC for Turkish as a second language. We investigated how error patterns in frequency and density vary according to the learners' demographics (gender, number of known languages) and the source cultural domain of Turkish language learners.

LITERATURE REVIEW

In this section, to make the study even more comprehensible, firstly, we briefly explain the structure of the Turkish language. After that, we shared the theoretical background of the source cultural domains of non-native Turkish language learners. Finally, we provide theoretical approaches for defining error patterns.

The Structure of Turkish Language

Turkish belongs to the Turkic family of Altaic languages, alongside the Mongolic, Tungusic, Korean, and Japonic families. Approximately eighty million individuals in Turkiye, the Middle East, and Western European countries speak modern Turkish.

Morphologically, Turkish exhibits an agglutinative nature. The formation of words occurs through the concatenation of root words with affixes. Word formation involves the highly productive application of multiple suffixes to root words obtained from a lexicon comprising approximately thirty thousand root words, excluding proper names (Oflazer & Saraclar, 2018). The formation of a single word might convey the meaning of a whole sentence in English since Turkish words can have many inflectional and derivational suffixes. For example:

Gel+ebil+ecek+se+n -> If you will be able to come (here)

Instances of multiple derivations within a single word are frequent in Turkish. Arisoy (2009) provides an example of the word 'ruhsatlandirilamamasindaki' which consists of nine morphemes. This word conveys the general meaning 'related to (something) not being able to acquire certification'. It is a modifier of a noun within its contextual usage. Within the word itself, there are five derivations, depicted in Figure 1, wherein the process begins with the root word 'ruhsat' (certification) and culminates through five successive derivations in the form of a modifier. On average, a word in running text contains approximately three bound and unbound morphemes.

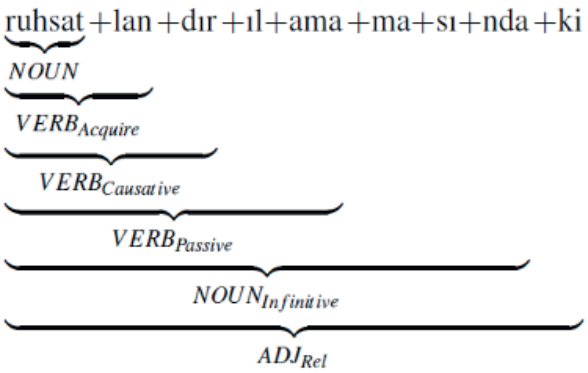

Figure 1. Derivations in a complex Turkish word (Oflazer & Saraclar, 2018)

Vowel harmony is a distinctive feature of Turkish morphology, ensuring that all the vowels within a word adhere to a consistent frontness or backness pattern, meaning that front vowels (e, i, o, u) coexist with other front vowels and back vowels (a, i, o, u) coexist with other back vowels. This system plays a crucial role in maintaining the harmonious sound structure of Turkish words. For instance:

Araba+lar; root word: car 'Araba' with back vowels (a), Suffix: -lar (plural) with the back vowel (a)

Ev+ler; root word house 'Ev' with front vowels (e), Suffix: -ler (plural) with the front vowel (e)

The default constituent order of a declarative sentence in Turkish is Subject-Object-Verb, while adjuncts can be placed relatively freely within the sentence. The example sentences below provided by Oflazer & Saraclar (2018) demonstrate variations in constituent order, each serving to encode specific discourse context and assumptions, while the main event described remains consistent: Ekin saw **Cagla**.

Ekin **Cagla'yi** *gordu. (Ekin saw* **Cagla***.)*

Cagla'yi *Ekin gordu. (It was Ekin who saw* **Cagla***.)*

Gordu Ekin **Cagla***'yi. (Ekin saw* **Cagla** *(but was not really supposed to see her.))*

Gordu **Cagla***'yi Ekin. (Ekin saw* **Cagla** *(and I was expecting that))*

Ekin gordu **Cagla***'yi. (It was Ekin who saw* **Cagla** *(but someone else could also have seen her.))*

Cagla*'yi gordu Ekin. (Ekin saw* **Cagla** *(but he could have seen someone else.)*

In conclusion, this section provides a brief overview of the key aspects of the Turkish language to facilitate a more accessible understanding of the methodological approach in error analysis. The language's complex and highly productive morphological system enables the expression of intricate concepts and nuances within a relatively concise word structure.

Cultural Domains in Turkish Language Learning

Although its agglutinative structure and relatively free constituent order make Turkish rich and effective, it also makes Turkish challenging to learn. Similarly, the Turkish lexicon might have such an effect on learning Turkish. The lexicons of root words in Turkish have been heavily influenced by Arabic, Persian, Greek, Armenian, French, Italian, German, and English because of interconnectedness and cross-cultural exchanges due to geographical proximity, cultural interactions, and temporal associations. It is not only the Turkish lexicon that exhibits this intercultural influence, but also Turkish culture itself. Turkish culture adopts, adapts, and transforms elements from other cultures while contributing its unique cultural characteristics to others. To understand the dynamics of cultural interaction, we refer to a study conducted by Ronen and Shenkar (2013).

Ronen and Shenkar (2013) consider religion, language, and geography as core variables of culture, a common lifestyle transmitted from one generation to another by acculturation and socialization. Religion could be a kind of culture because it transmits several variations of norms, values, beliefs, and behavior (Cohen, 2009)

that influence cognitions and emotions. Language commonly indicates cultural affiliation since it affects how culture members conceptualize the world. Therefore, linguistic studies highlight 'cultures of speaking' and pronunciation, vocabulary, or grammar variations. Geography also affects culture since gathering people together in a specific location depends on resource availability, climate, and population density in that particular location and represents shared values held by the groups.

In terms of these three core variables (religion, language, and geography), Turkish culture has influenced a variety of cultures and has been influenced by those cultures, especially during the Ottoman Empire period (1326-1922). At its height, the empire conquered most of southeastern Europe (including present-day Hungary, the Balkan region, Greece, and parts of Ukraine), portions of the Middle East (now occupied by Iraq, Syria, Israel, and Egypt), North Africa (as far west as Algeria), and large parts of the Arabian Peninsula (Yapp & Shaw, 2023). This wide separation of the Ottoman Empire led to a high degree of interaction between Turkish culture and the culture of occupied territories. Transcultural domains emerged among mainly Turkish, Balkan, Arabic, and Farsi nations (Yigit & Arslan, 2014) as categorized in Table 1 based on Ronen and Shenkar's (2013) study.

Table 1. Dominant Common Threads Among Cultural Domains of Turkish Learners as L2*

	SOURCE CULTURAL DOMAINS:			
	Arabic and Farsi Nations	Other Turkic Nations: Tajik Azerbaijani, Turkmen, Uzbek Kazakh, Gagauz, Oghuz, and others	Balkan Nations: Nations in the Balkan Peninsula and Southeastern Europe	Other Nations
TARGET CULTURAL DOMAIN: Turkish Culture	The dominant common thread is the *religion* between Arabic, Farsi, and Turkish cultures. The common religious belief is Islam in both cultures.	The dominant common thread is the *structure of language* between Turkic Nations. These cultures speak either Altaic languages or different dialects of the Turkish language.	The dominant common thread is *geography* between the Balkans and Turkish culture. There are still traces of the Turkish lifestyle (music, food, vocabulary, idioms) in this region since it is a former Ottoman Empire territory.	There is no common thread between source and target cultures.

**L2: Second language*

The dominant common thread is a religion among Turkish, Arabic, and Farsi cultures. All Turkic nations speak Altaic languages. Therefore, the dominant cultural common thread is the similar linguistic structure among Turkic Nations. Neither religion nor language structure is a common thread between Turkish and Balkan cultures. However, geography is. There are still traces of the Turkish lifestyle (music, food, vocabulary, idioms) in this former Ottoman Empire territory.

In addition to the commonalities above, it is crucial to consider the potential influence of source cultural domains on language errors. The dominant common thread among Turkish, Arabic, and Farsi cultures is religion. Furthermore, all Turkic nations speak Altaic languages, establishing a significant linguistic similarity. However, when examining Turkish and Balkan cultures, neither religion nor language structure emerges as a shared characteristic. Instead, geography serves as the connecting factor. Traces of the Turkish lifestyle, including music, food, vocabulary, and idioms, persist in this former Ottoman Empire territory, underscoring the enduring cultural impact across borders. Therefore, the source cultural domain may be pivotal in shaping language errors and patterns within a given linguistic context.

Theoretical Approaches to Defining Error Patterns

The errors made by second language learners, whether in speech or writing, are a subject of broad investigation and controversy among teachers, linguists, and psycholinguists (Keshavarz, 2012). According to Corder (1992), the main purpose of error analysis is to determine what a learner knows or does not know and to structure curricula and teaching activities according to the learners' needs.

Until the 1960s, it was believed that the mother tongue could influence the mistakes made by language learners, especially when these mistakes became habitual (Corder, 1992; Keshavarz, 2012). As a result, comparisons were made between the mother (source) and target languages to identify the causes of the errors. The central idea of contrastive investigation is that potential difficulties in learning a particular foreign language can be identified by systematically comparing the source and target languages and cultures.

In the ensuing decades, cognitive learning theories emerged, and error analysis techniques began to shift from the influence of the source language to the inherent difficulty of the target language, individual differences in learners, and cross-lingual influences (Doolan & Miller, 2012; Gass & Selinker, 2008; Lennon, 2008). While we cannot fully explain second language acquisition in behaviorist terms, such as native language interference, it is also incorrect to completely disregard the influence of the native language and culture (Dulay, et al, 1982; Keshavarz, 2012; Song, 2018). For instance, Jiang (2000) asserts that transfer from source language to target language is a common stage of the acquisition process. Several researchers, including Singleton (2000), Lasagabaster and Doiz (2003), Llach (2011), Naves et al. (2005), and Wang (2003), emphasize the influence of the source language on student errors.

According to Richards (1974), errors are linguistically defective or incomplete learning, such as lexical and grammatical errors, in the speaking and writing of a language. He categorizes errors into Interference, Intralingual, and Developmental Errors. Interlingual errors occur when elements from other languages are transferred into the target language. The number of languages a person knows may affect these interlingual connections (Forsyth, 2014; Neuser, 2017). Moreover, errors might arise from gender differences, with numerous studies examining gender and its implications for motivation, attitude, performance, learning strategy use, and learning style in second language learning (Almusharraf & Alotaibi, 2021).

Research on error analysis has shown that certain errors frequently recur among language learners, irrespective of their source language backgrounds, and seem more related to the intrinsic difficulty of the subsystem involved than to cross-lingual influence (Lennon, 2008). Based on this, several techniques of error analysis have been developed by scholars such as Corder (1967, 1973), Gass & Selinker (2008), and Keshavarz (2012), as shown in Table 2.

Table 2. Error Analysis Methods

Study by	Error analysis method
Corder (1967, 1973)	1. Data Collection 2. Identification of errors 3. Description of errors 4. Explanation of errors 5. Evaluation of errors
Gass & Selinker (2008)	1. Data Collection 2. Description of errors 3. Classification of errors 4. Definition of the frequencies of errors 5. Examination of error sources
Keshavarz (2012)	Data Collection a) Spontaneous (by free conversation or writing) b) Elicited (by translation, multiple-choice test) Identification Errors (Linguistic-Based Error Classification) Orthographic errors Lexico-semantic errors Morpho-syntactic errors Interpretation of Errors a) Authoritative b) Plausible

This study uses Gass & Selinker's (2008) error analysis methodology and Keshavarz's (2012) linguistic-based error classification. Keshavarz's classification is a framework for categorizing second-language writing errors based on three linguistic analysis levels; orthographic, lexico-semantic, and morpho-syntactic.

Orthographic errors (OE) involve incorrect spelling of words, possibly due to unfamiliarity with target language orthography, difficulty distinguishing between similar letters or sounds, or typing errors. Examples include:

Misspellings: e.g., 'recieve' instead of 'receive'

Omissions: e.g., 'writting' instead of 'writing'

Additions: e.g., 'accomodate' instead of 'accommodate'

Substitutions: e.g., 'teh' instead of 'the'

Lexico-semantic errors (LSE) concern the semantic properties of lexical items. These can include using an incorrect word, using a word in an inappropriate context, or misinterpreting a word's meaning. Causes could be limited vocabulary, unfamiliarity with the target language culture, or interference from the first language. Examples include the following:

Word choice errors: e.g., 'big' instead of 'huge'

Collocation errors: e.g., 'make friends' instead of 'make friends with'

Register errors: e.g., using informal language in a formal context

Idioms and expressions: e.g., 'hit the nail on the head' instead of 'hit the nail on its head.'

Morpho-syntactic errors (MSE) pertain to the grammatical structure of sentences. These can include errors in verb tenses, subject-verb agreement, word order, and punctuation. The causes could be limited knowledge of grammar rules, unfamiliarity with the target language word order, or interference from the first language. Examples include the following:

Verb tense errors: e.g., 'I go to the store yesterday' instead of 'I went to the store yesterday.'

Subject-verb agreement errors: e.g., 'The students are happy' instead of 'The students is happy.'

Word order errors: e.g., 'I love my dog' instead of 'My dog I love.'

Punctuation errors: e.g., 'I saw a cat, it was black' instead of 'I saw a cat. It was black.'

In conclusion, the study of errors in second language acquisition has evolved from focusing solely on native language interference to considering the intrinsic difficulty of the target language, individual learner differences, and cross-lingual influences. While recognizing the significant role of the native language and culture, scholars emphasize the common transfer stage from the source language to the target language in the acquisition process. Gender differences and the number of languages known also contribute to language errors. Error analysis methodologies, such as those proposed by Gass & Selinker (2008) and Keshavarz (2012), provide valuable insight into identifying and classifying errors, informing curriculum development and teaching strategies in second language instruction.

PURPOSE OF THE STUDY

Although the current literature on error analysis in English as a foreign language has laid the groundwork for further exploration, there is still a need to understand errors and error analysis in non-English foreign languages (Yigitoglu, 2015). Specifically, there is a lack of empirical research on error patterns among non-native Turkish learners. Only a few quantitative studies, such as Bayazit (2019), have begun to define these patterns with empirical evidence. However, only Kara (2010) provides detailed information about a diverse

sample. In his study of 1,324 students, Kara (2010) groups them by their native country's geographical location and spoken language. He then analyzes the error patterns of Turkish language learners using written and oral exams and surveys. Despite being a pioneering effort in understanding error patterns in Turkish as a second language, further research is needed.

This research aims to gain a comprehensive insight into how different cultural characteristics shape learners' errors at the beginner level, and investigates the following research questions:

1. What is the frequency and density of errors? (RQ1)
2. Is there a statistically significant relationship between error frequency and learner group? (RQ2)
3. Is there a statistically significant relationship between error frequency and the number of languages learners know? (RQ3)
4. Is there a statistically significant relationship between error frequency and gender? (RQ4)
5. Is there a statistically significant difference in error density by learner group? (RQ5)
6. Is there a statistically significant difference in error density by number of languages the learner knows? (RQ6)
7. Is there a statistically significant difference in error density by gender? (RQ7)

METHOD

This study uses a cross-sectional design, collecting data from a significant number of subjects at one point in time (Gass & Selinker, 2008). Our methodology, based on Gass & Selinker's (2008) error analysis approach, includes three steps: (1) Data collection; (2) Error description, classification, and coding; and (3) Analysis of error frequency and density. The following sections will discuss each step in detail, offering a thorough understanding of the research methodology used in this study.

Participants

We grouped the source cultural domains of Turkish language learners into four categories: Arabic and Farsi Nations, Turkic Nations, Balkan Nations, and Other Nations. This classification was based on three core variables; religion, language, and geography, as reported in Ronen and Shenkar's (2013) study. Our classroom observations showed that these four learner groups exhibited different tendencies and challenges when learning Turkish. Experiencing different challenges is primarily due to their unique cultural backgrounds. For instance, Arabic and Farsi students usually quickly grasp the idea behind traditions and cultural differences, especially those based on religion, and swiftly learn the related linguistic structures. Turkic students tend to understand grammar effortlessly in a short time. Balkan students, often familiar with Turkish lifestyle, music, food, vocabulary, and idioms, typically learn vocabulary faster. In contrast, learners from other nations with no common cultural thread with the target culture often find it most challenging to learn Turkish.

Despite these observations, we lacked sufficient empirical data to substantiate them. As a result, we conducted this research to investigate whether error patterns might indicate group differences in writing samples. We examined how these error patterns varied based on learner demographics, including their source cultural domain (Arabic and Farsi Nations, Turkic Nations, Balkan Nations, and other nations).

One hundred and seventy-seven non-native Turkish learners at the A1 level participated in the study. Based on their source cultural domain, the participants were assigned to one of four groups; Arabic and Farsi Nations (LG1), Turkic Nations (LG2), Balkan Nations (LG3), or other nations (LG4). The demographics of the learners appear in Table 3, in terms of gender, age, number of languages they know, and number of errors they made.

Table 3. The Demographics of the Participants

Learner Groups	# of Participants	Gender		Age			# of Languages Learner Knows			Coded Errors
		Female	*Male*	<20	20–24	24>	None	1	2>	# of Errors
LG1: Arabic & Farsi Nations	47	21	26	16	17	14	12	30	5	810
LG2: Turkic Nations	44	12	32	11	21	12	10	31	3	569
LG3: Balkan Nations	47	30	17	15	18	14	3	23	21	478
LG4: Other Nations	39	20	19	10	23	6	18	19	2	855
Total	177	83	94	52	79	46	43	103	31	2,712

The participants in LG1 were from Afghanistan (*n* = 9), Syria (n = 8), Iraq (*n* = 7), Yemen (*n* = 7), Iran (*n* = 6), Morocco (*n* = 3), Palestine (*n* = 3), Jordan (*n* = 2), Saudi Arabia (*n* = 1), and Algeria (*n* = 1). The participants in LG2 were from Kazakhstan (*n* = 14), Kyrgyzstan (*n* = 10), Mongolia (*n* = 6), Crimea (*n* = 4), Turkmenistan (*n* = 4), Uzbekistan (*n* = 2), Tajikistan (*n* = 2), Moldova (*n* = 1), and Uzbekistan (*n* = 1). The participants in LG3 were from Bosnia and Herzegovina (*n* = 18), Albania (*n* = 7), Kosovo (*n* = 5), Montenegro (*n* = 4), Serbia (*n* = 3), Ukraine (*n* = 3), Macedonia (*n* = 2), Moldova (*n* = 1), Hungary (*n* = 1), Poland (*n* = 1), Serbia (*n* = 1), and Slovenia (*n* = 1). Finally, the participants in LG4 were from the United States (*n* = 5), Somalia (*n* = 4), China (*n* = 3), Philippines (*n* = 3), Russia (*n* = 3), Benin (*n* = 2), South Korea (*n* = 2), Haiti (*n* = 2), Comoros (*n* = 2), Bangladesh (*n* = 1), Brazil (*n* = 1), Gambia (*n* = 1), India (*n* = 1), Cameroon (*n* = 1), Colombia (*n* = 1), Liberia (*n* = 1), Mozambique (*n* = 1), Niger (*n* = 1), Swaziland (*n* = 1), Uganda (*n* = 1), Venezuela (*n* = 1), and Zambia (*n* = 1).

Data Collection

To conduct this research, Turkish and Foreign Languages Research and Application Centers across Turkiye were invited to participate. Those centers that agreed to join the study were provided with detailed instructions and were required to complete a consent form to ensure ethical compliance.

Data collection involved eight different higher education centers in Turkiye, which contributed by supplying the writing exams of participants for error coding. The exams were based on the Common European Framework of Reference for Languages (CEFR), which was established by the Council of Europe in 2011. Alongside these exams, a demographic survey was also conducted, gathering information on the participants' gender, age, and multilingual capabilities; specifically the number of languages they are proficient in. This comprehensive approach aimed to analyze language acquisition errors at the foundational A1 level, thereby providing insight into early language learning challenges within the Turkish context.

Error Description, Classification, and Coding

Our coding scheme was developed based on Keshavarz's (2012) Linguistic-Based Error Classification, which includes Orthographic Errors (OE), Lexico-Semantic Errors (LSE), and Morpho-Syntactic Errors (MSE). Table 4 reports the coding sheme of OE which refers to spelling errors..

Table 4. The Coding Scheme for OE: Variables, Values, and Examples

Codes	Error examples	Correct (or expected) writing
Letter error: (A)	Zeyif	zayif
Letter error: (B)	panyo	banyo
Letter error: (C)	sicakkanli	sicakkanli
Letter error: (C)	cunku	cunku
Letter error: (E)	mesala	mesela
Letter error: (G)	Kirgizistan	Kirgizistan
Letter error: (G)	begeniyorum	begeniyorum
Letter error: (I)	yaklasik	yaklasik
Letter error: (I)	yermi	yirmi
Letter error: (O)	uynuyoruz	oynuyoruz
Letter error: (O)	doner	doner
Letter error: (P)	bara	para
Letter error: (S)	herkez	herkes
Letter error: (S)	kizi	kisi
Letter error: (U)	Biz bulustuk	Biz bulustuk
Letter error: (U)	Kutuphaneye gidiyoruz.	Kutuphaneye gidiyoruz.
Letter: (Z)	muse	muze
Letter error: Others	tar	dar
Lowercase and uppercase errors	Kardesim ile turkce konusuyoruz.	Kardesim ile Turkce konusuyoruz.
Letter misordering	biligsyara	bilgisayar
Doubling of consonants	derss	ders
Dropping one of the double consonants	dukan	dukkan
Missing or extra letters	Basket	baskent
Sound-Letter mismatch	yeyanim	yegenim
Not writing the vowels	Geleck hafta	Gelecek hafta
Writing the word the same as it is in the learner's mother language	universitet	universite
Apostrophe errors	Batuma gidecegim.	Batum'a gidecegim.
Comma errors	Kar, ve yagmur	Kar ve yagmur
Full stop errors	Onlar ogrenciler. ve Eritre'de yasiyorlar.	Onlar ogrenciler ve Eritre'de yasiyorlar.

Table 5 reports the coding sheme of the LSE, which pertains to errors tied to the semantic properties of lexical items.

Table 5. The Coding Scheme of the LSE: Variables, Values, and Examples

Codes	Error examples	Correct (or expected) writing
Co-occurrence error	kahvalti yedim	kahvalti ettim
Conjunction error	Oda ogrenci	O da ogrenci
Incorrect word order	Resmi Ataturk'un var.	Ataturk'un resmi var.
Using one word instead of another with similar pronunciation	Sinif	sinav
Adding inaccurate extra words	Dus almak yapiyorum.	Dus aliyorum.
Omitted or missing words	Onun esinin Emine	Onun esinin adi Emine
Semantic meaningfulness	Daha sey seviyorum. Butun sey en seviyorum.	

Table 6 reports the coding sheme of the MSE, which involves errors connected to grammatical structure.

Table 6. The Coding Scheme of the MSE: Variables, Values, and Examples

Codes	Error examples	Correct (or expected) writing
Error while devoicing of 't' as 'd'	Yemekden once	Yemekten once
Error while devoicing of 'c' as 'c'	Turkce	Turkce
Error while voicing of 'g, g' as 'k'	Bebeki	Bebegi
Error while voicing 't' as 'd'	Yurta	Yurda
Error while voicing 'c' as 'c'	Kirgizca	Kirgizca
Vowel harmony error	bittiktan	bittikten
Error of epenthesis: I, I, U, U	suryor	suruyor
Error of haplology: I, I, U, U	Benim sehirim	Benim sehrim
The buffer letter '-y' error	okuacagim	okuyacagim
Vowel mutation in negative and positive structures (-ma, -me, -a, -e)	yasayorum.	yasiyorum.
Derivational suffix -lik	Pilot okuyor.	Pilotluk okuyor.
Derivational suffix -li	kisa sac	kisa sacli
Derivational suffix -siz	mutlusuz	mutsuz
Accusative case suffix -i	Ayasofya muzesi'ne geziyorum.	Ayasofya Muzesi'ni geziyorum.
Dative case suffix –e	Nijer donecegim.	Nijer'e donecegim.
Ablative case suffix -den, -dan	Trabzon'da sevgilerle	Trabzon'dan sevgilerle
Locative case suffix -de	Universitesin okuyorum	Universitede okuyorum
Plural case suffix error	3 turistik yerler var.	3 turistik yer var.
Misusage of personal suffix in verb	yaptin	yaptim
Possessive suffix error	Ben pazartesi ders var.	Benim pazartesi dersim var.
The suffix –ki error	Arkadaslarim Irakta cok ozledim.	Irakta'ki arkadaslarimi cok ozledim.
Pronoun error	benim gittim	ben gittim
Pronominal -n error	masanin ustude	masanin ustunde
Noun phrase error	dunyanin en son ulke	dunyanin en son ulkesi
Negation word (degil)	cok farkli yok.	cok farkli degil.
Negation particle '-me -ma' error	Ben tren sevmeyorum.	Ben tren sevmiyorum.
Adding inaccurate extra suffixes	Yurttada kaliyorum	Yurtta kaliyorum
Copula error	ogretnenim	ogretmenim
Present continuous tense error	O, cay seviyorun.	O, cay seviyor.
Future tense error	okuyacam	okuyacagim
Past tense error	Dort yil once ben ve Mustafa sik sik beraber ders calisiyoruz, geziyoruz, sohbet ediyoruz.	Dort yil once ben ve Mustafa sik sik beraber ders calistik, gezdik, sohbet ettik.

Under this schemes, we analyzed one hundred and seventy-seven writing exam papers and coded 2,712 errors using NVivo, a qualitative data analysis software. After coding the papers for various error types, the data was exported to a Microsoft Excel spreadsheet. After this, we created two rectangular matrices for statistical tests. The rows represent the participants, and the columns represent each participant's attributes (demographics) and errors. The first matrix was for counting error frequency, which was binary coded: a '1' was entered in a cell if the participant made an error, and a '0' was entered if no error was made. This matrix, whose structure is shown in Figure 2, indicates how many participants made a specific error.

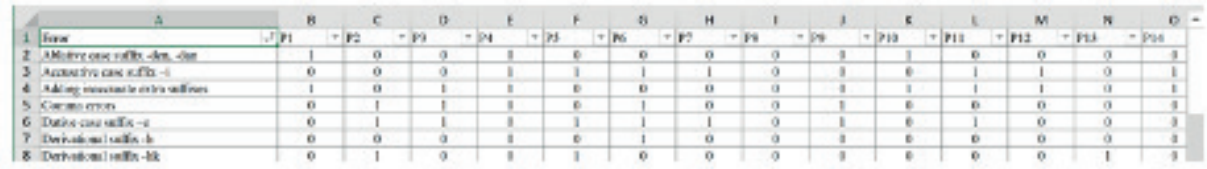

Figure 2. The structure of the error frequency matrix

The second matrix is used for error density calculation and is coded in decimal. Each cell contains the error count per participant. This matrix, whose structure is shown in Figure 3, indicates the frequency of each error made by the participant. In other words, it represents the total occurrence of a specific error.

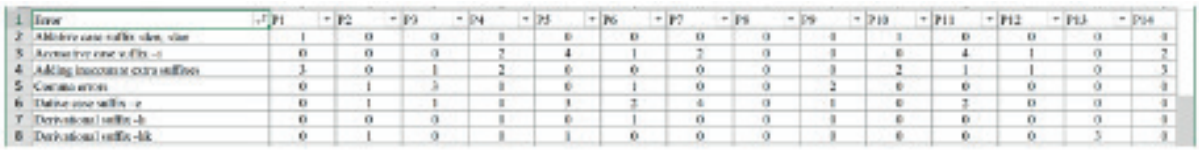

Figure 3. The structure of the error density matrix

To ensure precise and consistent categorization, we started by jointly coding 20% of the exam papers. In cases of disagreement, we engaged in discussion until we reached a consensus. We then individually coded an added 15% of the sample to assess inter-rater reliability. The coding scheme was finalized once the overall agreement rate hit 89.4%. Following Saldana's (2015) and Oswald and Plonsky's (2010) advice, each researcher coded half the remaining exam papers. Every coded error was cross-verified by another subject matter expert to ensure reliability. All coders were Ph.D students in the Teaching Turkish as a Foreign Language program and had at least four years of experience.

Analysis of Error Frequency and Density

After establishing the frequency and density matrices, we conducted inferential statistical tests. A chi-square test of independence examined the relationship between the variables in RQ2, RQ3, and RQ4. We applied a Kruskal-Wallis H test to analyze the difference between the variables in RQ5 and RQ6. Cramer's V measured the effect size for the chi-square test of independence, while epsilon square gauged the effect size for the Kruskal-Wallis H test. We also used the Bonferroni approach to evaluate pairwise differences among the learner groups. Lastly, we performed a Mann-Whitney U test to examine the difference between the variables in RQ7.

FINDINGS

This section presents the major findings of the study.

Frequency and Density of Errors

Our initial research question inquired into the frequency and density of errors. Table 7 provides a comprehensive overview of the frequency and density of the most common errors participants made.

Table 7. The Frequency and Density of Errors

		Density*		Frequency**	
Category	Error	n	%	n	%
OE	Letter error: (I)	367	9,1	109	6,5
OE	Uppercase errors	373	9,2	91	5,4
OE	Letter error: (U)	202	5,0	88	5,2
OE	Letter error: (I)	247	6,1	84	5,0
OE	Apostrophe errors	153	3,8	75	4,4
OE	Missing or extra letters	147	3,6	74	4,4
OE	Writing words the same as in the learner's mother language	170	4,2	74	4,4
OE	Lowercase errors	211	5,2	62	3,7
OE	Letter error: (E)	165	4,1	53	3,1
OE	Letter error: (U)	62	1,5	47	2,8
OE	Full stop errors	190	4,7	46	2,7
OE	Letter misordering	51	1,3	37	2,2
MSE	Noun phrase	291	7,2	111	6,6
MSE	Adding inaccurate extra suffixes	167	4,1	86	5,1
MSE	Accusative case suffix –i	171	4,2	85	5,0
MSE	Possessive Suffix	187	4,6	84	5,0
MSE	Locative case suffix -de	139	3,4	77	4,6
MSE	Sound-Letter mismatch	183	4,5	77	4,6
MSE	Vowel harmony	118	2,9	63	3,7
MSE	Dative case suffix –e	99	2,5	60	3,6
MSE	Pronominal -n	82	2,0	55	3,3
LSE	Incorrect word order	138	3,4	81	4,8
LSE	Using one word instead of another with a similar pronunciation	127	3,1	68	4,0
	TOTAL	4040	100	1687	100

* Refers to the total number of times the particular error was made.

** Refers to the total number of participants who made a particular error.

Orthographic errors related to letter errors, such as errors with the letter '**I**' and uppercase errors as well as morphosyntactic error noun phrase errors stand out as the most frequent and dense categories. These errors highlight challenges participants faced in correctly using Turkish characters and adhering to orthographic rules, and participants struggled notably with constructing and using noun phrases correctly in Turkish. Morphosyntactic errors like adding inaccurate extra suffixes, inaccurately using accusative case suffixes, and issues with possessive suffixes also appear frequently among the errors. These errors indicate difficulties participants encountered in mastering the morphological and syntactic aspects of the Turkish language. On the other hand, lexical-semantic errors, such as incorrect word order and using one word instead of another with similar pronunciation, although less frequent, still contributed significantly to the overall error distribution.

Relationship between Error Frequency and Learner Group

Our second research question asked whether there would be a statistically significant relationship between error frequency and learner group. A chi-square test of independence was performed to examine the relationship between error frequencies and learner groups. The relationship between these variables was significant, albeit with a small effect size, $x^2(66, N = 1687) = 137.964$, $p < .01$, $V = .165$. This suggests that while there is a relationship between error frequencies and learner groups, the strength of this relationship

is not particularly strong. In other words, the learner group a participant belongs to may influence error frequencies, but other factors likely also play a role. Error frequencies of learner groups are provided in Table 8 in terms of count and percentile.

Table 8. The Error Frequency* Distribution of the Learner Groups

Errors	LG1: Arabic and Farsi Nations	LG2: Turkic Nations	LG3: Balkan Nations	LG4: Other Nations	Total
	n (%)	n (%)	n (%)	n (%)	n (%)
Noun phrase	35 (32%)	23 (21%)	23 (21%)	30 (27%)	111 (100%)
Letter error: (I)	31 (28%)	24 (22%)	24 (22%)	30 (28%)	109 (100%)
Letter error: (U)	17 (19%)	23 (26%)	20 (23%)	28 (32%)	88 (100%)
Adding inaccurate extra suffixes	21 (24%)	12 (14%)	27 (31%)	26 (30%)	86 (100%)
Accusative case suffix –i	23 (27%)	12 (14%)	28 (33%)	22 (26%)	85 (100%)
Possessive Suffix	21 (25%)	13 (15%)	25 (30%)	25 (30%)	84 (100%)
Letter error: (I)	19 (23%)	24 (29%)	21 (25%)	20 (24%)	84 (100%)
Incorrect word order	22 (27%)	14 (17%)	22 (27%)	23 (28%)	81 (100%)
Sound-Letter mismatch	20 (26%)	24 (31%)	14 (18%)	19 (25%)	77 (100%)
Locative case suffix -de	23 (30%)	11 (14%)	18 (23%)	25 (32%)	77 (100%)
Writing words the same as it is in the learner's mother language	19 (26%)	19 (26%)	17 (23%)	19 (26%)	74 (100%)
Missing or extra letters	22 (30%)	15 (20%)	16 (22%)	21 (28%)	74 (100%)
Using one word instead of another with a similar pronunciation	9 (13%)	17 (25%)	17 (25%)	25 (37%)	68 (100%)
Vowel harmony	23 (37%)	10 (16%)	11 (17%)	19 (30%)	63 (100%)
Dative case suffix –e	16 (27%)	10 (17%)	16 (27%)	18 (30%)	60 (100%)
Letter error: (E)	30 (57%)	11 (21%)	2 (4%)	10 (19%)	53 (100%)
Letter error: (U)	16 (34%)	11 (23%)	7 (15%)	13 (28%)	47 (100%)
Letter misordering	13 (35%)	8 (22%)	4 (11%)	12 (32%)	37 (100%)

* Refers to the total number of participants making the particular error.

The relationship between error frequency and learner group is also provided in Figure 4 in a visual form for the sake of readability, considering the available large data set.

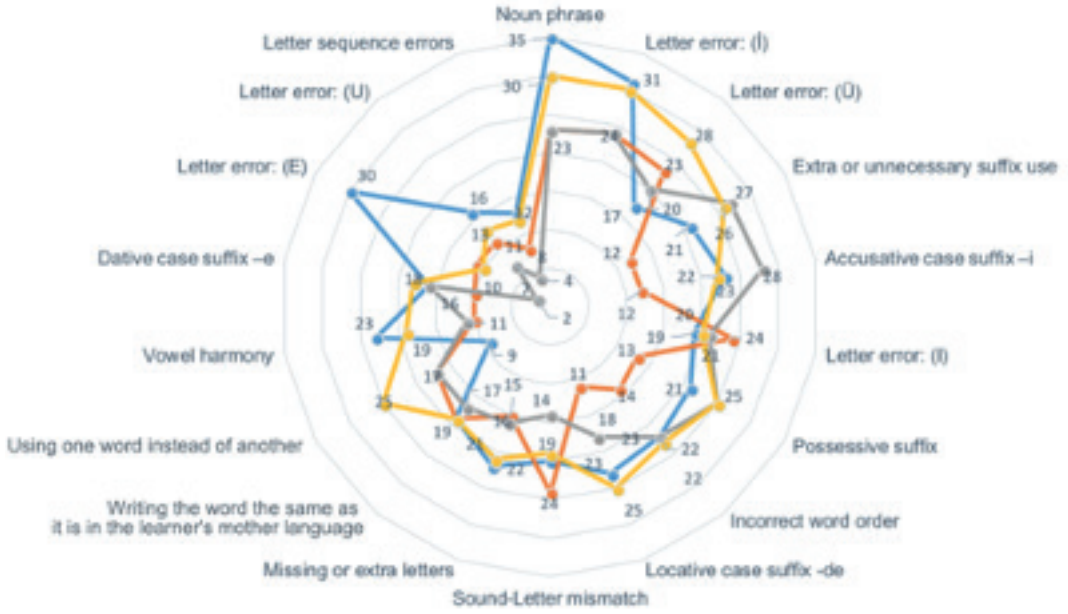

Figure 4. The Relationship between Error Frequency and Learner Group

The most common error across all groups is the 'Noun phrase', with 111 participants (32%) making this mistake. The next frequently occurring errors include letter errors like '**İ**', '**U**', and 'I'. These errors seem to be fairly evenly distributed across the learner groups, although certain slight variations can be observed. On the other hand, the letter error E is most common in Arabic and Farsi Nations while least common in Balkan nations. The Turkic Nations make accusative case suffix -i error less frequently than the other groups. In summary, while there are common errors observed across all learner groups, there are also distinct patterns and variations that can be attributed to the learners' native languages and linguistic backgrounds.

The Relationship between Error Frequency and the Number of Languages the Learner Knows

Our third research question asked whether there would be a significant relationship between error frequency and the number of languages a learner knows. A chi-square test was performed, and no relationship was found between error frequency and the number of languages the learner knows, x^2 (44, N = 1687) = 35.338, p = .82. This indicates that, knowing more languages does not appear to influence the frequency of errors made by learners. These results challenge the common assumption that multilingualism might lead to a better or worse performance in language learning.

The Relationship between Error Frequency and Gender

Our fourth research question asked whether there would be a statistically significant relationship between error frequency and gender. A chi-square test was performed, and no relationship was found between error frequency and gender; x^2 (22, N = 1687) = 24.744, p = .31. This indicates that while there might be variations in the types of errors made by male and female learners, these differences do not reach statistical significance when considering error frequency alone.

The Difference in Error Density by Learner Group

Our fifth research question asked whether there would be a statistically significant difference in error density by learner group. A Kruskal-Wallis H test showed that there was a statistically significant difference in error density by learner group; $x^2(3)$ = 39.626, $p < .01$, x^2 = 0.024. Specifically, the mean rank error

scores were 927.48 for LG1 (Arabic and Farsi Nations), 867.04 for LG4 (Other Nations), 780.70 for LG2 (Turkic Nations), and 751.17 for LG3 (Balkan Nations). Although the statistically significant difference was observed, the effect size was small, which suggests that the practical significance of the results might be modest.

Table 9. Results of Kruskal-Wallis H Test; Error Density* by Learner Group

Learner Groups	n	Mean	sd	x^2	p	
LG1: Arabic and Farsi Nations	517	2.92	3	39.626	0.001	LG1–LG4, LG2–LG3
LG2: Turkic Nations	337	2.13				
LG3: Balkan Nations	354	1.84				
LG4: Other Nations	479	2.42				

* Refers to the total number of times the particular error was made.

Follow-up tests were conducted to evaluate pairwise differences among the four groups, controlling for Type 1 error across tests using the Bonferroni approach. The results of these tests indicate a significant difference between:

- LG3 and LG4 U(N_{LG3} = 354, N_{LG4} = 479) = 72916.00, z = -3.71, p <.001,
- LG3 and LG1 U(N_{LG1}) = 517, N_{LG3} = 354) = 72331.00, z = -5.59, p <.001,
- LG2 and LG4 U(N_{LG4} = 479, N_{LG2} = 337) = 72430.50, z = -2.68, p = .007,
- LG2 and LG1 U(N_{LG1} = 517, N_{LG2} = 337) = 72248.00, z = -4.74, p < .001.

None of the other comparisons were significant after the Bonferroni adjustment. The density of errors was greater for LG1 than for LG3 and LG2. It was also greater for LG4 than for LG3 and LG2. These findings suggest that there are notable variations in error density across different learner groups, with learners from Arabic and Farsi nations exhibiting the highest error density compared to other groups. This underscores the importance of considering learner backgrounds when designing language learning interventions to address specific learning challenges effectively.

The Difference in Error Density by the Number of Languages the Learner Knows

Our sixth research question asked whether there would be a statistically significant difference in error density by the number of languages the learner knows. A Kruskal-Wallis H test was performed, and there is no statistically significant difference in error density by the number of languages the learner knows; $\mathbf{x}^2(sd$ = 2, n = 1687) = 4.870, p = 0.088. This suggests that the number of languages known by a learner may not significantly influence the density of errors made during the learning process.

The Difference in Error Density by Gender

Our seventh research question asked whether there would be a statistically significant difference in error density by gender. The results of the Mann-Whitney U test indicate a statistically significant difference in error density between male and female learners U(N_{Female} = 768, N_{Male} = 919) = 326325.50, z = -2.85, p < 0.01. The negative z-value (-2.85) suggests that female learners had a lower error density compared to male learners.

DISCUSSIONS AND CONCLUSION

Although various recent studies have practiced an error analysis approach, few studies have adopted this approach to less commonly taught languages (Kang & Chang, 2014). The error analysis approach could be highly relevant in exploring the acquisition of agglutinating languages, such as the Turkish language, in which the morphology and syntax are perceived as a source of great difficulty (Bayazit, 2019). This approach

would advance our understanding (Polio, 2013), and as Yigitoglu and Reichelt (2012) state, we may have a clear sense of Turkish learners' needs.

While there are countless studies on learning and teaching a language as a foreign language worldwide, it is noteworthy that the studies on learning and teaching Turkish as a foreign language within the scope of applied linguistics are limited. Existing studies on errors made by learners of Turkish as a foreign language exhibit limitations in terms of scope and sample size. Typically, these studies focus on specific linguistic areas and specific native language backgrounds of learners, or involve a small number of participants. Therefore, a comprehensive understanding of the errors made by Turkish language learners based on different variables is still lacking. Unlike other studies, this study tries to emphasize the comparison of four groups determined within the framework of the cultural domain as well as the effect of gender and the number of languages they know on the errors made by learners. The error typology developed within the scope of this study will be able to successfully evaluate the extent to which learners have a good knowledge of Turkish, especially spelling and grammar.

According to our results, the relationship between error frequencies and the learner group is significant. Most errors made by LG1 were noun phrase errors, vowel harmony errors, missing or extra letters, letter misordering, and letters I, U, and E errors. Other research in the field has similar results. For example, it is reported that students whose native language is Arabic and who use the Arabic alphabet make noun phrase errors (Adalar Subasi, 2010; **Cicek** & Kaplan, 2016; Kara, 2010; Polat, 1998) in addition to vowel harmony errors (Adalar Subasi, 2010; **Cicek** & Kaplan, 2016; Kara, 2010; Polat, 1998). Those students also have difficulty writing vowels in Turkish (Adalar Subasi, 2010; Bolukbas, 2011; Okatan, 2012; Kara, 2010; **Sengul**, 2014). It is reported that students are frequently confused in regard to writing the vowel sounds and use /a/-/e/, /i/-/i/ (**Cicek** & Kaplan, 2016; Kara, 2010; Okatan, 2012), /u/-/u/ (Okatan, 2012; Polat, 1998), and /e/-/i/ (**Cicek** & Kaplan, 2016; **Sengul**, 2014) interchangeably. **Sengul** (2014) states that students cannot distinguish these letters while writing because vowel sounds are not represented with a letter in the Arabic alphabet; instead, these sounds are represented with accents using above or below consonants. Kara (2010) stated that foreign students who use the Arabic alphabet, especially from the Middle East, do not write one of the double consonants in words. He claimed this error stems from making double consonants with shadda while writing in their language. It was found that the students, whose native language was Persian, and who used the Persian alphabet while learning Turkish as a foreign language, made errors in noun phrases, vowel harmony, and the mixing of similar sounds such as i-i, o-o, and u-u (Boylu, 2014; **Inan**, 2014). **Inan** (2014) states that the reasons for the errors in vowel harmony and the mixing of similar sounds, such as i-i, o-o, u-u was the fact that the phonological structure of Turkish is different from Persian, being six vowels in the Persian alphabet (/a/, / a /, / e /, / i /, / o /, / u /) in comparison to eight vowels in the Turkish alphabet, and confusion of the vowels /i/, /u/, /o/, which were especially not found in Persian, with the vowels /i/, /u/, /o/.

We found that most errors made by LG2 were letter 'I' error and sound-letter mismatch errors. Similarly, Albayrak (2010) states that Mongol students were confused about the i-i sounds. Yilmaz (2015) and **Ozdemir** and Arslan (2017) states that Kazakhs made errors with dotted vowels, and the inability to distinguish dotless vowels (3.0%) was among the important problems encountered while writing. **Ozdemir** and Arslan (2017) states that v, g, i, u, h, c, s, e, c, i, t were the vowels and consonants that Kazakh students frequently made errors with in reading and writing. Kumsar and Kaplankiran (2016) states that Kazakh students often made errors by writing the letter /i/ instead of the /i/ sound. Aydogmus (2018), Barin (1998), Erdogan (2005) and Kumsar and Kaplankiran (2016) states that students wrote /v/ instead of /b/, /s/ instead of /c/, /n/ instead of /h/, /r/ instead of /p/, /u-u/ instead of /y/, and /g/ instead of /d/. They explain that the reason for these mismatch errors is that there are many similar letters between the Turkish and Kazakh alphabets. They also state that letters are in the same form but are pronounced differently. They also explain that letters such as /c/ and /g/, are unique to the Turkish alphabet but not to the Kazakh alphabet.

According to our results, most errors in LG3 were using extra or unnecessary suffix and accusative case suffix –i errors. Similarly, Ak Basogul and Can (2014) states that students from the Balkan Nations made errors, particularly in using the accusative case suffix –i.

Most errors made in LG4 were letter U error, dative case suffix –e, using the wrong word instead of another, and locative case suffix -de errors. Our results show similarities with other studies. For example, Demir and

Gulec (2015) and **Sengul** (2014) state that their students had difficulty with the /u/ sound and used the /u/ sound instead of the /u/ sound. They claim that the main reason for these errors is the absence of the /u/ sound in the learner's mother language. Polat (2014) found no /u/ sound in Russian and; as a result, Russian learners frequently make letter U errors. In addition, he claims that Russian learners often made the dative case suffix –e and locative case suffix –de errors since the dative case suffix –e and locative case suffix –de in Russian are sometimes used with prepositions and sometimes without prepositions.

The error percentage for the letter 'i' was the same for LG1 and LG4. Using incorrect word order was an error commonly made by LG1, LG3, and LG4. Writing Turkish vocabulary with the same word as the one in the mother language was a common error for all the learner groups.

In addition, there was a statistically significant difference in error density by learner group. The results indicate a significant difference between LG1 and LG3, LG1 and LG2, LG2 and LG4, and LG3 and LG4. There was no significant difference between LG2 and LG3 in terms of error density, and there was no significant difference between LG1 and LG4. LG2 and LG3 were similar in most cases and, similarly, LG1 and LG4 were similar.

On the other hand, no relationship was found between the error frequency and the number of languages the learner knows. Similarly, there was no difference among the groups in error density by the number of languages the learner knows. These outcomes align with the findings of Neuser's (2017) investigation on lexical transfer, where a significant L1 status effect was found rather than an L2 status effect. In contrast, our research results diverge from Torusdag's (2020) findings, which indicate that students acquiring Turkish as their initial foreign language exhibit a higher frequency of written expression errors than those learning it as their second or third language. Furthermore, Forsyth's (2014) research highlights the presence of negative syntactic L2 transfer from German and Italian in English L3. The primary distinction between transfer in second language acquisition and transfer in third or fourth language acquisition lies in the learner's capacity to leverage multiple background languages when confronted with gaps in the target language (Neuser, 2017). This delineation holds significant implications for developing future language teaching strategies and systems, particularly in light of the increasing prevalence of multilingual acquisition in contemporary society.

No relationship was found between error frequency and gender. Our findings, in terms of the total number of errors by gender, are in line with the earlier research of Almusharraf and Alotaibi (2021), Lahuerta (2020), and Nair and Hui (2018). On the other hand, there is evidence to suggest that gender may influence error density in the learning process, with the female learners showing better performance in terms of error density compared to the male learners in this study.

As a result, the analysis of language errors among four distinct learner groups, LG 1 (Arabic and Farsi Nations), LG 2 (Turkic Nations), LG 3 (Balkans Nations), and LG 4 (Other Nations), revealed specific error patterns. These patterns guided the development of adaptive instructional content. For example, OEs varied across the groups; LG 1 struggled with '**I**', while LG 2 had issues with 'I.' LG 4 had problems with '**I**' and '**U**'. Both LG 1 and LG 4 showed specific letter errors with 'E' and 'U,' as well as misordering letters. Interestingly, LG 3 did not display specific OEs.

The most common MSE was the noun phrase error common among LG 1 and LG 4, which led to targeted instruction in this area for both groups. Both LG 3 and LG 4 often added inaccurate extra suffixes, necessitating tailored content addressing suffix usage accuracy for these groups. Specific suffix errors, such as the accusative case suffix '-i' and possessive suffix, were identified in LG 3 and LG 3/LG 4, respectively. LG 2 did not display specific MSEs.

Incorrect word order was a shared challenge among LG 1, LG 3, and LG 4, requiring focused instruction on this aspect. In addition G 4 struggled with writing words similar to their mother language. Interestingly, LG 2 did not display specific LSEs.

By tailoring content to address these distinct error patterns, the language acquisition process was optimized for each learner group. This facilitated more effective and targeted learning experiences. By identifying the distinct weaknesses caused by source culture, we could tailor our instructional approach, offering targeted assistance and practice opportunities to different learner groups according to their error distribution, as outlined in Table 10.

Table 10. The adaptation strategy according to the learner groups' error distribution

Error Type	Error	Learner Groups			
		LG 1: Arabic and Farsi Nations	LG 2: Turkic Nations	LG 3: Balkans Nations	LG 4: Other Nations
OE	Letter error: (I)	X			X
OE	Letter error: (I)		X		
OE	Letter error: (U)				X
OE	Letter error: (U)	X			
OE	Letter error: (E)	X			
OE	Letter misordering	X			X
OE	Sound-Letter mismatch		X		
OE	Missing or extra letters	X			X
MSE	Noun phrase	X			X
MSE	Accusative case suffix –i			X	
MSE	Locative case suffix -de	X			X
MSE	Dative case suffix –e				X
MSE	Possessive Suffix			X	X
MSE	Adding inaccurate extra suffixes			X	X
MSE	Vowel harmony	X			
LSE	Incorrect word order	X		X	X
LSE	Writing words the same as it is in the learner's mother language				X

In this study, we examined the writing error patterns of non-native Turkish learners for offering targeted assistance. The outcomes of our study have been instrumental in pinpointing specific areas where students encounter difficulties in the language. The results were used in the preparation and adaptation of teaching materials for the Learn Turkish Adaptive Massive Open Online Course (https://xxx.xxx.xxx.xx).

Overall, error analysis is a powerful tool for designing adaptive MOOCs that are more effective and efficient at helping students learn and improving their foreign language skills. It is a relatively new approach to educational design. Adaptive MOOCs are still in the early stages of development, and there is ample room for innovation. Using error analysis to design adaptive MOOCs is a novel approach to improve the effectiveness and efficiency of these courses. Moreover, this is an interdisciplinary approach; Combining error analysis with educational technology can create new and innovative ways to help students learn. There may be certain limitations to this study. The first is gathering demographic data from students through self-reporting. Formal records and in-depth interviews are ideal for obtaining background data regarding participants. However, accumulating large amounts of data from numerous learners renders self-reporting an indisputable limitation of the study. The second limitation is the language proficiency of learners. It is limited to the CEFR A1 level, where learners can understand and use basic expressions to satisfy concrete needs, such as introducing themselves and asking others questions concerning personal details. Future research is suggested to replicate this study for other CEFR levels (A2, B1, B2, C1, and C2) of language proficiency. In doing so, future researchers could gain and share important insights into students' error patterns.

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BIODATA and CONTACT ADDRESSES of AUTHORS

Dr. Ozlem OZAN is an Associate Professor at Yasar University's Faculty of Communication, specializing in Open Educational Resources (OER), educational content development, and instructional design. She holds a Ph.D. in Distance Education and has an extensive research background in open and distance learning, digital learning environments, and research methodologies. Dr. Ozan's scholarly contributions focus on educational technology and inclusive learning environments, with a particular emphasis on the development and implementation of OER for diverse learner populations. Her research interests encompass mobile learning, social networks, and connectivist learning environments, contributing to the advancement of innovative pedagogical approaches. In addition to her research, she teaches courses on Research Methods, Social Network Analysis, and Digital Content Design, integrating theoretical and practical perspectives to enhance digital learning strategies. Her work aims to bridge the gap between technology and education, fostering accessibility and engagement in digital learning contexts.

Ozlem OZAN
New Media and Communication, Faculty of Communication
Address: Yasar University, Universite Caddesi, No:35-37, Agacli Yol, Bornova, Izmir, TURKIYE
Phone: +90 232 570 8431
E-mail: ozlem.ozan@yasar.edu.tr

Dr. Yasin OZARSLAN is a Full Professor of Educational Technology at Yasar University. He holds a doctorate in Distance Education (2013), a master's in Organizational Management (2007), and a bachelor's degree in Electrical and Electronics Engineering (2002). Additionally, he is a research professor in Learning Technologies, Open and Distance Learning, Learning & Experience Design, and Digital Transformation in Education at the Science Culture Department at Yasar University, Izmir Turkiye. He also holds the esteemed positions of Dean of the Faculty of Science & Letters and Director of the Open and Distance Learning Research Centre at Yasar University. He has directed and participated in research projects related to educational technology and has published several books and scientific articles in international journals.

Yasin OZARSLAN
Science Culture Department, Faculty of Science & Letters
Address: Yasar University, Universite Caddesi, No:35-37, Agacli Yol, Bornova, Izmir, TURKIYE
Phone: +90 232 570 7482
Email: yasin.ozarslan@yasar.edu.tr

Dr. Sevgi CALISIR ZENCI is an Associate Professor of Turkish Language and Literature at Anadolu University, Faculty of Letters. She graduated from Ankara University DTCF Department of Linguistics in 2003. She completed her master's degree at Anadolu University, Department of New Turkish Language, in 2007. She received her doctorate degree in Linguistics-Foreign Language Teaching from Ankara University in December 2015. Her academic interest areas are second language acquisition, cognitive linguistics, distance Turkish teaching, discourse analysis, and language use. She has published articles, book chapters and papers presented at national and international conferences in her field.

Sevgi CALISIR ZENCI
Turkish Language and Literature, Faculty of Letters
Address: Anadolu University, Yunus Emre Campus, 26470, Eskisehir, Turkiye
Phone: +90 222 335 05 80
E-mail: sevgicalisir@anadolu.edu.tr

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