

AI-ENHANCED ERROR ANALYSIS: IDENTIFYING INTERLINGUAL AND INTRALINGUAL ERRORS IN ACADEMIC WRITING OF UNIVERSITY STUDENTS

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ABSTRACT

This study investigates the efficacy of AI tools to identify and classify writing errors in university students' essays, focusing on interlingual and intralingual errors. Since writing errors significantly hinder the academic performances of non-native students, the demand for efficient and automated error detection methods has become increasingly evident. The present research incorporates AI-based tools such as OpenAI Playground and PyCharm within a quantitative research design to analyze error frequency and types. Existing error detection methods often lack scalability and accuracy when addressing the complexities of language learning. This method incorporates an automated system to improve academic writing by systematically identifying, categorizing and offering corrective feedback. The results indicate that AI effectively identifies both interlingual and intralingual errors. While intralingual errors were categorized with relative ease, interlingual errors presented greater complexity due to subtle overlaps. Furthermore, AI currently lacks sensitivity to context, culture and linguistic differences of the native speaker's language, which hinders the process of developing a reliable framework for interlingual error categorization. Present study demonstrates that AI provides comprehensive and time-efficient solutions for automated error analysis, thus enhancing the effectiveness of instructional interventions. The methodology offers precision and relevance across diverse language learning contexts. Future researchers may expand this AI model to accommodate more complex writing contexts and incorporate a broader range of languages.

Keywords: Error analysis, interlingual errors, intralingual errors, AI-enhanced error analysis, error analysis of university students, error categorization

1. INTRODUCTION

Academic writing is a cornerstone of both academic and professional development of non-native speakers of English. Despite its significance, many university students encounter persistent challenges in mastering academic writing, principally due to interlingual and intralingual errors. Interlingual errors occur due to interference of the first language (L1) whereas intralingual errors occur due to complexities of the second language (L2). Traditionally, such errors are regarded as barriers to academic success and effective communication. However, Canagarajah (2006) argues that multilingual writers are not passive but active learners who creatively use multiple languages and contexts to achieve their rhetorical goals.

The growing diversity of university populations with students representing a wide range of linguistic backgrounds, highlights the importance of addressing writing challenges. As a result, first languages of students impact their English writing which is influenced by both cultural and language differences. As emphasized by Corder (1981) interlingual errors occur frequently in

English academic writing when students directly transfer structures from their native languages to English. For instance, the impact of Urdu sentence structure leads to incorrect phrasing of sentences in students' writing. If non-native English speakers do not address this issue timely, it can hinder their academic writing progress.

The traditional methods of error detection in academic writing have primarily relied on the manual feedback from the instructors. Although existing methods offer valuable insights but they are often subjective, time-consuming and prone to inconsistent results. Consequently, many students do not rectify their writing errors because the feedback provided often does not address their individual learning needs. Callies (2015) has explained that modern tools can enhance error detection and analysis, offering a more efficient solution than human feedback. However, recent researches lack systematic AI-driven solutions that are made for categorizing and correcting writing errors of university students. Although, AI tools have been applied to detect basic grammatical errors but their ability to address interlingual and intralingual errors remains underdeveloped.

The present study addresses these writing challenges faced by the university students, especially the non-native speakers of English. It aims to explore the potential of AI tools to identify, categorize and offer real-time data-driven feedback that helps students in improving their writing skills. The objective of present research is to automate the error detection process by using AI technology. These tools not just identify the common grammatical errors but also categorize the interlingual and intralingual errors into sub-categories. This research aims to fill the gap by developing and testing prompt-based frameworks in OpenAI Playground designed to identify, categorize and correct writing errors in university students' essays by offering precise and targeted feedback.

This research aims to:

1. Identify most prevalent interlingual and intralingual errors in university students' essays and explore how AI can systematically identify them
2. Categorize writing errors using AI-driven tools
3. Design custom frameworks and prompts for detecting and categorizing interlingual and intralingual errors using OpenAI Playground.

2. LITERATURE REVIEW

Errors in the writings are not just barriers but diagnostic windows in language acquisition. Early linguists like Corder (1967) explained that the errors made by the students reflect their cognitive and linguistic strategies, helping to differentiate between interlingual and intralingual errors. On the same principle AI is aiding the error analysis, allowing teachers to give quick and targeted feedback. A combination of Corder's insight with AI tools can create a more effective approach to language learning.

According to Flower and Hayes (1981) "Writing is best understood as a set of distinctive thinking processes which writers orchestrate or organize during the act of composing" (p. 366). This idea highlights the fact that writing tasks involve cognitive complexity and students must manage various mental tasks simultaneously. Non-native English speakers face problems in writing due to L1 interference and insufficient understanding of L2 complexities. Students face challenges in writing tasks due to limited language skills, a lack of understanding of writing rules, overthinking, and cultural differences (James, 1998). Addressing these challenges require a strategy bridging linguistic support and techniques to reduce cognitive load.

Selinker (2014) explained that interlingual errors originate when learners apply first language rules to the second language. For instance, a learner may use a structure from L1 that does not align with the grammatical norms of English. In contrast, Intralingual errors occur due to overgeneralization L2 rules such as misuse of prepositions. English writing errors can also be placed into lexical, grammatical and syntactical categories.

Corder (1967) identified lexical errors, such as the use of "eventually" instead of "finally," as a common occurrence among non-native speakers. These errors typically arise due to similarity between the words and contextual confusion. Richards (1974) noted that syntactical errors occur when sentence patterns are explicitly transferred from the first language, resulting in unnatural or incorrect structures.

Language transfer is an essential concept in second language acquisition (SLA), as it explains how a learner's first language (L1) influences the second language (L2). The influence may be positive when similarities in L1 and L2 facilitate the language learning or negative when the differences in L1 and L2 result in errors (Odlin, 1989). For example, when a French speaker misuses the English word "actually" to mean "currently" due to its similarity with the French word "actuellement". Recent research suggests that AI tools can be handy in identifying such errors when machine learning algorithms are trained on L1 and L2 datasets.

Overgeneralization is another key term in SLA where learners apply the grammatical rules too broadly. It is actually an attempt of a learner to internalize language rules but this attempt is followed by incorrect applications. Corder identified overgeneralization as an important part of error analysis, emphasizing that it shows attempts by learners to adopt the rules of the target language (1967). AI tools use natural language processing (NLP) for identifying overgeneralization errors where a student might use "goed" instead of "went" and provide a corrective feedback. "Educational feedback has been widely acknowledged as an effective approach to improving student learning. However, scaling effective practices can be laborious and costly, which motivated researchers to work on automated feedback systems (AFS)" (Dai et al., 2023, p. 323). AI-driven feedbacks offer tailored solutions and bridges the gaps between conventional teaching methods and modern technology.

Interlanguage is an important concept that describes the developing linguistic system created by learners while acquiring a second language. Interlanguage reflects influence of native language (L1) structures and developmental stages of second language (L2). As students' progress, their interlanguage exhibits unique traits that can be analyzed for pedagogical purposes (Selinker, 1972). AI technologies are compatible for detecting errors across competence levels, track changes in learners' interlanguage over time, and provide valuable insights into learners' developmental progress.

Robert Lado's Contrastive Analysis Hypothesis (CAH) was introduced in 1957 and remains a foundational theory in SLA. It explains how differences between a learner's first language (L1) and target language (L2) influence learning but CAH was widely criticized by cognitivists. Swan (2007) critiques the widespread discrediting of CAH in the 1970s, with the rise of cognitive and nativist models of language learning and reflects on the early value he found in CA during his teaching career. The core idea of CAH is that similarities within languages are easy to learn but differences are difficult. "The teacher who has made a comparison of the foreign language with the native language of his students will know better what the real learning problems are and can better provide for teaching them" (Lado, 1957, p. 2).

Recent advancements in AI tools have greatly impacted language learning and assessment, especially in the error analysis of English writings. A growing body of research has explored the effectiveness of AI-based systems to identify and rectify grammatical errors. Park (2019) compared AI-based English grammar checkers with the human raters in evaluating the writings of EFL learners. The study assessed the efficiency and accuracy of AI tools in detecting grammatical errors. Findings revealed that AI tools were effective for identifying basic errors like those of subject-verb agreement and verb tenses but less reliable in addressing complex and context related errors. The human raters achieved 89% accuracy and AI achieved 78% accuracy; supporting the use of both for language assessment.

Jamshed et al. (2024) investigated the effect of ChatGPT's feedback on the writing samples of 132 Indian students of secondary public school. The eight-week quasi-experimental design had the experimental group receiving AI-based feedback while the controlled group received traditional teacher feedback. Statistical analysis including paired sample t-tests and independent sample t-tests showed significant improvements in the experimental group at the $p < 0.05$ level, particularly in reducing errors related to plural form, tense and subject-verb agreement errors.

Almusharraf and Alotaibi (2023) conducted a study on the effectiveness of an automated essay scoring system with human evaluators by employing a quantitative approach. The study used Corder's 1974 error analysis framework to analyze 197 EFL essays and found a positive correlation between Grammarly and human raters. The AES was effective for identifying spellings and verb form errors while human raters were more accurate with complex issues of sentence fragments and punctuation.

In conclusion, AI-based error analysis offers a powerful approach for enhancing the language instruction. Further researches into AI capabilities are likely to play an effective role in uplifting the educational practices.

3. RESEARCH DESIGN & METHODOLOGY

3.1 Research Design & Methodology

The computational framework for the proposed model is divided into three phases: data preparation, error detection using AI, and result analysis.

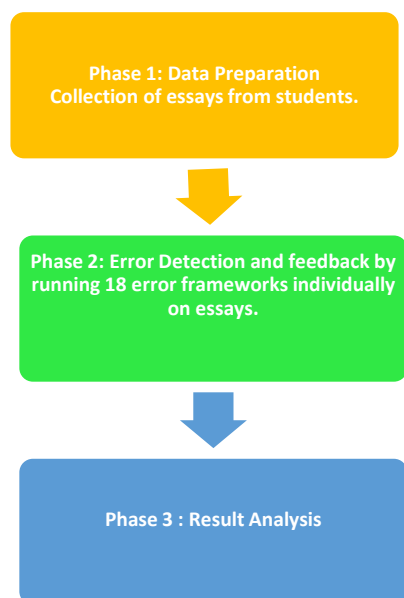


Figure 3.1 illustrates three phases of the research framework. In the first phase the data for present research was collected from university students in Pakistan across all four provinces. A total of 100 essays were selected, each essay was written in English by students with Urdu as their native language. Essays were typed in Notepad to ensure that no automated grammar or spellings suggestions appeared. Data collection was completed within one week in university computer labs where students participated voluntarily.

In second phase 100 essays were processed using 18 error frameworks, each dedicated to specific types of grammatical errors such as noun usage, verb tenses, articles, prepositions etc. These frameworks were created using XML format and applied using AI-based

analysis with OpenAI's GPT-4o mini. Each framework was executed individually and AI analyzed every sentence to identify, categorize and offer corrective feedback.

In third phase the obtained results were compiled and saved into CSV format for further analysis. For the analysis, a cut-off threshold of 200 was established so the most prevalent interlingual and intralingual errors with a frequency of 200 or above were presented in tables and diagrams, while those below the threshold were excluded.

3.2 Tools and Technology

The experiments for the proposed computational method were implemented using Playground OpenAI's GPT-4o mini model on PyCharm Community Edition. The system was developed on a laptop with Windows 10 Pro 64-bit OS, equipped with an Intel Core i7 vPro EliteBook processor, 8 GB of RAM 7.88 GB usable, and a 64-bit, x64-based processor.

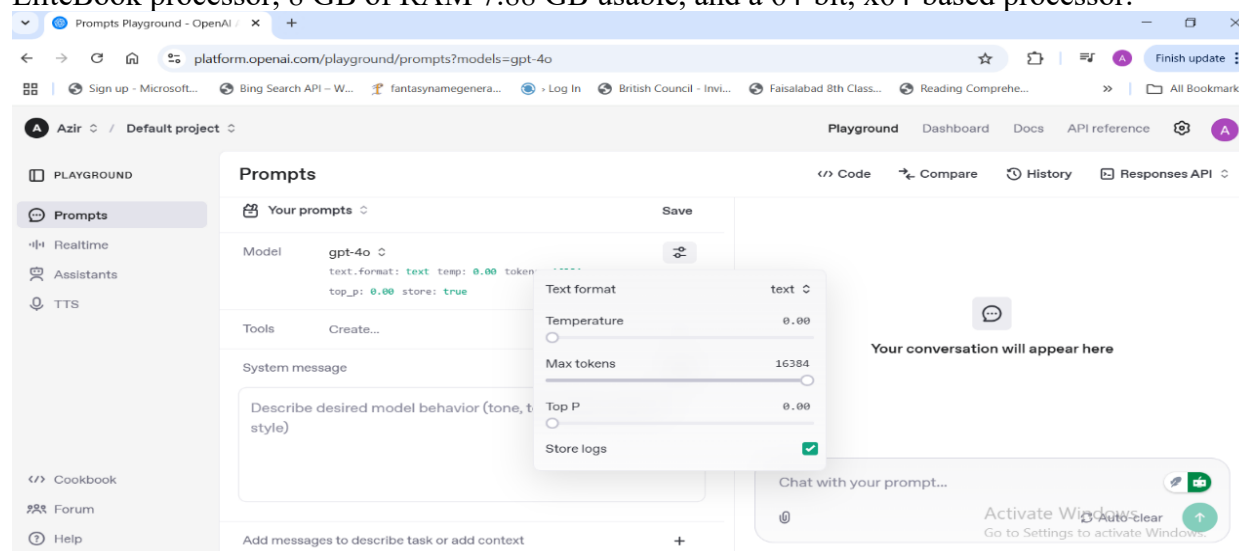


Figure 3.2: Configuration of Open-AI Playground

Figure 3.2 explains the configuration of Open-AI Playground where the temperature was set to 0 and maximum token limit of 16,384 words to ensure consistent error detection. Temperature set to 0 ensured a focused and deterministic response while maximum token limit allowed the model to analyze longer texts. Additionally, Top P set to 0 restricted the model to select only the most probable next words, thus enhancing precision in error detection.

Each sentence was analyzed individually. For example, if no adjective error was found 'NONE' was recorded and no error was tagged. In case of an error related to adjective, the framework tagged the 'Major Type Tag' as either interlingual or intralingual, then it identified the specific 'Sub Type Error' e.g. Redundant Adjective and finally provided a corrected version in the justification column.

In this manner, all the 18 error frameworks were executed separately and results were compiled into CSV format for further analysis. For automation, PyCharm Community Edition 2024.3 was used where a user-friendly graphical user interface (GUI) facilitated easy management of input and output files. The program required input folder, output folder, prompt file and OpenAI API key. Once initiated, the program automatically processed all 100 essays and stored the results in the designated output folder.

4. DATA PRESENTATION & ANALYSIS

4.1 Results and Discussions

The results are presented systematically, followed by a detailed discussion in light of the study's research questions.

4.1.1 What types of interlingual and intralingual errors are most prevalent in university students' writing, and how can AI systematically identify them?

One of the significant challenges observed in student writing was the occurrence of interlingual errors caused by Urdu interference. These errors are the result of the direct translation of ideas from Urdu to English. Some of the notable errors are as follow:

Table 4.1.1 A Frequency of Interlingual Errors			
Error Type	Main Category	Sub Category	Frequency
Interlingual	Articles	Incorrect Article Usage	837
Interlingual	Conjunctions	Coordinating Conjunctions	366
Interlingual	Forms	Misusing Capitalization	357
Interlingual	Forms	Spelling Errors	526

Table 4.1.1 A shows that incorrect article usage is one of the most prevalent errors as they were identified 837 times. Students misused or omitted articles due to their limited usage in Urdu for example 'the' has been used for general terms like 'social media' or 'online shopping' which is incorrect. AI can effectively identify such errors.

Coordinating Conjunctions appeared 366 times. The flexible use of conjunctions in Urdu leads to errors in English, particularly with the overuse or incorrect placement of "and". For example, in Essay 72, Line 9, a student incorrectly joined clauses so the error was identified and corrected sentence was given by separating the ideas and using 'and' appropriately.

The use of capitalization has been misused 357 times. As Urdu lacks capitalization rules, students write "pakistan" for "Pakistan" or "monday" for "Monday." AI-driven tools can identify capitalization errors by scrutinizing sentences for proper nouns and the initial word of each sentence.

Spelling Errors were identified 526 times and they were largely due to phonetic nature of Urdu, it lacks silent letters and complex spelling rules. Examples include "knowlage" instead of "knowledge" or "furnitures" instead of "furniture." AI can tag such errors easily and offer correction by comparing wrong spellings with database of correct spellings.

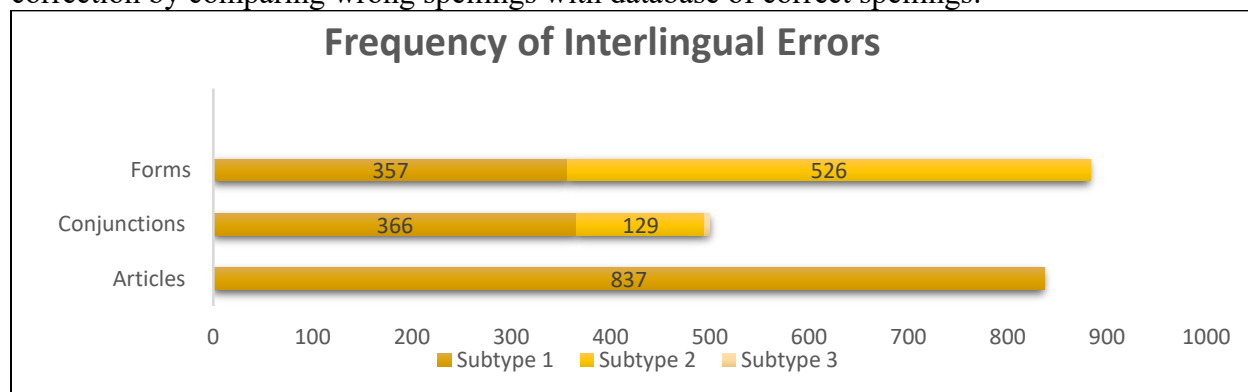


Figure 4.1.1 A: Frequency of Interlingual Errors

The intralingual errors identified were primarily due to the details and complexities of English grammar, independent of the students' native language. These errors arose from issues such as noun form errors, tense errors, punctuation mistakes, and more. Following is the table showing the most prevalent Intralingual Errors and the frequency of errors.

Table 4.1.1B Frequency of Intralingual Errors

Error Type	Main Category	Sub Category	Frequency
Intralingual	Noun	Plural Form Errors	219
Intralingual	Verb	Tense Errors	273
Intralingual	Developmental Errors	Overuse of And	325
Intralingual	Pronoun	Pronoun Agreement	230
Intralingual	Preposition	Simple Preposition	226
Intralingual	Punctuation	Omission of Punctuation	321
Intralingual	Punctuation	Confused Punctuation Marks	283

Table 4.1.1 B maintains that Plural form errors were identified 219 times in the essays. Most of the errors were due to incorrect usage of singular and plural nouns as in 'student' instead of 'students' to match the subject 'they'. Such errors highlight the need for explicit instruction on singular and plural noun agreement.

Tense errors were the most frequent type of intralingual error, appearing 273 times across the essays mostly when verb forms were incorrectly conjugated. For example, in Essay 72, line 13, the phrase "It complete depend on the human interest" is incorrect because "depend" requires the adverb "completely" to modify it correctly. The corrected version is: "It completely depends on human interest."

Overuse of "and" was a frequent intralingual error, occurring 325 times in the essays. This error results in run-on sentences where multiple ideas are connected without proper punctuation. For example, in Essay 39, line 7, "and" is misused to link unrelated ideas.

Pronoun agreement errors occurred 230 times, they appear when a pronoun does not agree in number or gender with the noun it refers to. These errors are common among students due to the complexities of English grammar rather than L1 interference. This error reflects challenges in mastering subject-verb agreement as seen in 'it provide' instead of 'it provides'.

Figure 4.1.1 B is a horizontal bar-chart showing the most prevalent intralingual errors at a glance.

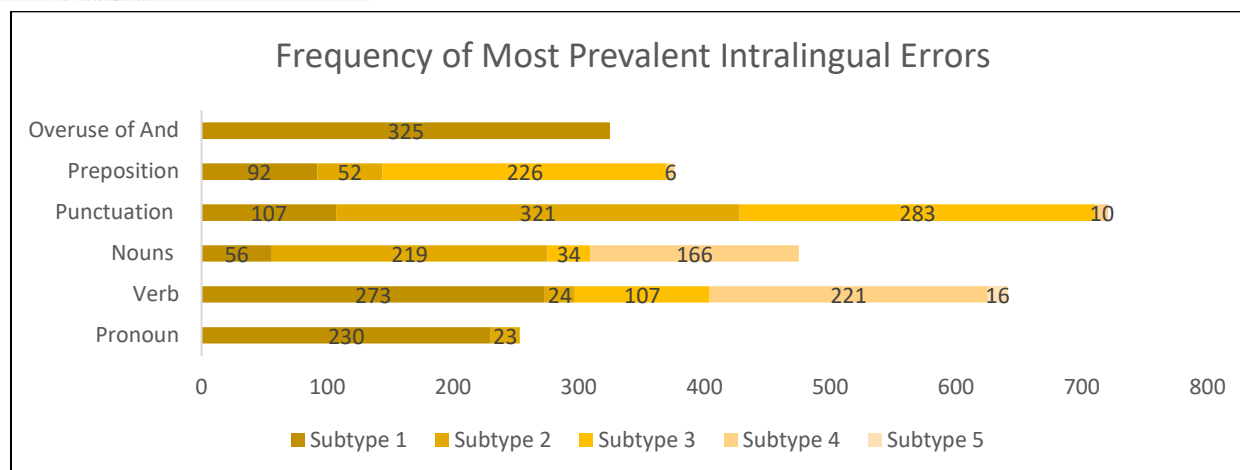


Figure 4.1.1 B: *Frequency of most prevalent Intralingual Errors*

4.1.2 How can interlingual and intralingual errors be effectively categorized?

Interlingual Errors occur due to the interference of first language in this case from Urdu which has different grammatical structures, syntax and rules as compare to English. Following are the reasons for categorization of these errors into interlingual category.

Adverb-Adjective Confusion is classified as an interlingual errors as they result from the influence of Urdu. The differences in adjectives and adverbs in Urdu are not as complex as they are in English. This is why students confuse adverbs and adjectives while translating Urdu expressions into English. Connective adverbs are classified as interlingual errors because Urdu frequently uses adverbs at places where conjunctions are used in English. The absence of clear difference between the conjunctions and adverbial functions in Urdu results in errors when learners use connective adverbs in English.

Incorrect article usage is placed in interlingual category because Urdu doesn't feature articles like a, an and the. There is a structural difference between Urdu and English which results in the frequent omission and incorrect article usage. The auxiliary verb tense formation is also classified as interlingual error due to a reason that Urdu has a specific tense formation system that does not use auxiliary verbs in the same manner as English does so students having L1 Urdu tend to use auxiliary verbs incorrectly while constructing tenses in English.

Coordinating Conjunctions are categorized in interlingual category as Urdu usage of conjunctions does not align with the English. The common error of coordinating conjunction like "and" is either misused or overused due to influence of Urdu. Learners apply the Urdu usage of "and" in English flexibly and end in making errors. Similarly, Subordinating Conjunctions and Correlative Conjunctions have been also categorized in interlingual category.

Capitalization and spelling errors fall under interlingual category due to structural differences in Urdu and English. Contrary to English, Urdu does not emphasize on capitalization of proper nouns and first word of the sentence due to which students wrongly apply the capitalization rules. Moreover, Urdu is a phonetic language and has a direct sound to script relationship whereas English follows irregular patterns of spellings. The phonetic influence of Urdu on learners is the cause frequent spelling errors in English writing.

Placement of pronoun errors primarily fall under the interlingual category due to distinct differences in the structures of Urdu and English. Another reason of placing this error in intralingual category is the difference in subject-verb agreement and emphasis patterns between

Urdu and English. In Urdu, pronouns usage is implied when the subject is indirect whereas English requires explicit usage of the pronoun. Moreover, Urdu offers a great deal of flexibility in the pronoun positioning and learners apply the same flexibility while translating the sentences from Urdu to English due to which learners produce unnatural English sentences.

Intralingual errors occur regardless of the first language's influence, they arise from the intrinsic complexities of English language which can be challenging for second language learners. Therefore, errors related to adjectives, adverbs, auxiliary verbs, excessive use of 'And', existential there, verbs et cetera are all placed into intralingual category.

4.1.3 How can custom frameworks and prompts be designed for detecting and categorizing interlingual and intralingual errors using OpenAI Playground?

Eighteen error frameworks were created based on common grammar issues encountered by university students in their English writing for detecting and categorizing errors. These frameworks covered a wide range of errors related to parts of speech e.g., adjectives, adverbs, verbs, nouns, punctuation, and sentence structure. Each framework was specifically designed to handle a particular category of error. For every framework, prompts were made with clear instructions regarding required actions, rules for analysis, justification and required output.

Prompt: As an expert in English and Computer Science, interpret the provided XML framework or criteria and analyze the structured user input given as JSON. The JSON will contain a key-value pair with "line_number" as a line number, and "sentence" as the corresponding English input text. The text within the JSON is interconnected. Using the classification tags from the provided framework, apply all relevant tags to the JSON. You must accurately tag the sentences, identifying and assigning appropriate SubTypes for the MainType. Additionally, for every tag you apply, provide a detailed justification, explaining why each specific tag was chosen.

The main categories were selected based on the common issues faced by Urdu speaking students when writing in English. The subcategories were then improved to focus on specific types of errors within the main categories for example the adjective framework had subcategories for adjective form errors, adjective placement errors and redundant adjectives. The prompts included instructions, examples and specific criteria. For instance, for Noun usage errors the prompt might include an instruction like, 'Detect errors in the use of countable and uncountable nouns, if the noun is incorrectly used, tag it as an error of noun usage. These prompts were designed to include several example-driven instructions to facilitate the model in understanding typical errors for each category. This ensured that AI could tag common and complex errors.

After the initial design of the frameworks and prompts several tests-runs were performed to refine the accuracy and consistency of the framework. Each framework was executed separately on the essay so that errors may be tagged similarly. During the testing phase it was ensured that all the error tagging was same across multiple runs by adjusting the prompts and checking the results, any inconsistency or contradiction in results was noted and prompt revision was made accordingly. Accuracy was achieved when the error categories were fine-tuned and prompt instructions were adjusted by testing the frameworks on smaller sets of essays, by comparing the outputs.

5. DISCUSSION & CONCLUSION

5.1 Discussion

One of the key findings revealed that intralingual errors such as incorrect auxiliary verb usage, inconsistencies with verb tenses and noun errors were accurately tagged as they aligned with the predictable patterns of English grammar. On the contrary, the identification of interlingual

errors required a sophisticated understanding of Urdu and English. Errors in article usage, pronoun placement, coordinating conjunctions and adjective-adverb confusion, spellings and capitalization were categorized as interlingual errors due to structural features present in English but absent in Urdu.

The study also revealed that AI-driven frameworks and prompts offered effective tagging of errors although AI has limited capacity of developing a deeper contextual understanding. A noteworthy advantage was the accessibility of OpenAI Playground, which proved user-friendly and manageable with basic familiarity and online tutorials. However, certain tasks require technical expertise like automating the process through PyCharm, generating CSV outputs and integrating API key. Free tools like ChatGPT and Claude are available online but Playground was selected due to its temperature-controlled error tagging. The OpenAI playground incurred a cost of \$18 (including tax) for running 18 frameworks but the cost was justified by the quality of results.

Another challenge was the higher error frequency. For example, while dealing specific issues such as overuse of “And”, errors related to punctuation were also tagged, leading to overrepresentation of certain categories. Additionally, the issue of scalability can be of great concern in resource constrained academic environments since present research requires computing infrastructure and a stable internet connection.

Overall, the above stated findings highlight both the strengths of AI-enhanced error analysis and the areas that require refinement. Future researchers may expand interlingual categories to reflect learners’ native languages and develop models that incorporate the sociolinguistic awareness so that errors can be better interpreted in multilingual settings.

5.2 Conclusion

The present study was conducted to achieve three objectives: to identify most prevalent interlingual and intralingual errors, to categorize the errors and to design custom frameworks and prompts for tagging the errors using OpenAI playground. All the objectives were met successfully as methodology involved designing the frameworks and prompts which proved effective and replicable. Identification and categorization of Intralingual errors was smoothly done. However, for interlingual errors a different approach was adopted, which focused on distinguishing linguistic features that are present in English but absent in Urdu. All the essays were initially processed through the intralingual error detection frameworks but errors like article misuse, pronoun placement, spelling errors and capitalization errors were categorized as interlingual errors. The decision was taken after taking a close examination of native language interference as errors of such kind depict structural gaps between English and Urdu. However, continuous adjustments were made in the frameworks to ensure accurate representation of errors in respective categories. Despite several bottlenecks such as handling context-based sentences and managing automation workflows, the overall process of error analysis remained effective. The setup of Pycharm and API integration for automation required technical expertise but it was successfully implemented. In conclusion, the present study offers a feasible and replicable model for using AI-enhanced tools for error analysis and correction strategies.

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