

An Intelligent Writing Tutor for ESL Learners: A Rule-Based and NLP-Assisted Feedback Framework

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Abstract—Writing remains one of the most challenging skills for English as a Second Language (ESL) learners because it requires the coordinated application of grammar, vocabulary, and written discourse conventions. This study proposes an Intelligent Writing Tutor that integrates corpus-informed error analysis, natural language processing (NLP), and rule-based reasoning to generate individualized and explainable writing feedback for ESL learners. Guided by a mixed-methods Design Science Research approach, weekly journal entries produced by Ilocano-speaking English language majors at the Kalinga State University served as the learner corpus for analysis. Manual expert annotation based on Corder's Error Analysis framework identified lexical, morphological, syntactic, and mechanical errors that informed the development of an interpretable rule-based feedback engine. The analysis revealed that morphological errors were the most frequent, followed by mechanical, lexical, and syntactic errors, with verb tense misuse emerging as the dominant writing difficulty. Qualitative findings further indicated that many of the observed errors reflected first-language interference, particularly in tense marking, subject–verb agreement, preposition usage, and lexical choice. The proposed framework operationalizes learner texts through preprocessing, NLP-assisted error detection, rule-based error classification, feedback generation, and recommendation modules to produce individualized feedback reports. The study demonstrates the feasibility of integrating explainable NLP techniques and second language acquisition principles into an educational writing support system. Because the framework was developed using journal writings from Ilocano-speaking learners in a single institution, its applicability to other learner populations requires further investigation.

Keywords—*Corpus-informed instruction; educational technology; English as a Second Language; Intelligent Writing Tutor; natural language processing; rule-based feedback*

I. INTRODUCTION

Writing proficiency is a fundamental component of second language acquisition (SLA) and an essential competency for academic success, professional communication, and lifelong learning. Among learners of English as a Second Language (ESL), writing is often regarded as one of the most challenging language skills because it requires the simultaneous coordination of linguistic knowledge, discourse organization, vocabulary selection, and grammatical accuracy. Difficulties in writing frequently emerge from learners' limited mastery of the target language and the influence of their first language (L1), resulting in persistent errors that impede effective communication [1], [2].

Early studies on error analysis established that learner errors are not random occurrences but valuable indicators of the

language acquisition process. Corder argued that errors reveal learners' underlying hypotheses about the target language and provide insights into instructional needs [3], [4]. Similarly, Dulay and Burt emphasized that second language errors reflect developmental strategies employed by learners as they construct interlanguage systems [5]. These perspectives shifted the focus of language instruction from merely correcting mistakes to understanding the cognitive and developmental mechanisms underlying learner performance.

Interlanguage theory further explains that learners gradually develop an independent linguistic system that incorporates characteristics of both the native and target languages. Such systems evolve dynamically as learners receive additional exposure to the target language [6], [7]. Krashen likewise proposed that language acquisition occurs through meaningful input and progressive internalization of linguistic structures, although learners may continue to exhibit transitional forms during the acquisition process [8]. Consequently, ESL writing errors should be interpreted not solely as deficiencies but as developmental manifestations that require targeted pedagogical responses.

Among the factors contributing to writing difficulties, L1 interference remains one of the most extensively investigated phenomena in SLA research. The transfer of native language structures often affects syntax, morphology, vocabulary use, and discourse organization in learners' written production [9], [10]. Studies conducted among Chinese, Indonesian, Malaysian, and other multilingual ESL populations consistently demonstrate that negative transfer contributes significantly to recurring grammatical errors and non-native patterns in writing [11], [12].

Research has documented various manifestations of native language interference, including tense inconsistency, omission of articles, subject–verb disagreement, inappropriate lexical selection, and direct translation from the mother tongue [13], [14]. Such transfer effects frequently interact with developmental errors arising from incomplete acquisition of English grammatical rules [15], [16]. These findings highlight the need for instructional approaches capable of distinguishing between developmental mistakes and transfer-induced errors to facilitate more effective intervention.

Contemporary investigations further reveal that learner errors exhibit systematic patterns that can inform instructional design. Dependency relations, conceptual transfer, and bilingual processing mechanisms influence the production and interpretation of written texts among language learners [17], [18]. Visual analyses of SLA research trends likewise indicate growing scholarly interest in bilingual acquisition, interlanguage

development, and evidence-based pedagogical practices aimed at improving writing performance [19], [20].

Traditional approaches to writing instruction primarily rely on teacher-mediated feedback. Although teacher feedback is widely recognized as valuable, it often requires considerable time and effort, particularly in large classes where individualized guidance becomes difficult to sustain. Learners may consequently receive delayed feedback, limiting opportunities for immediate revision and reflection [21], [22]. These limitations have encouraged the exploration of technology-enhanced instructional approaches capable of providing timely and consistent support.

Recent advances in natural language processing (NLP) and artificial intelligence have transformed educational practices through the development of intelligent systems capable of analyzing textual data and generating meaningful recommendations. NLP techniques have demonstrated effectiveness in extracting linguistic features, identifying patterns, and supporting automated analysis across diverse domains [23], [24]. In educational contexts, such technologies offer opportunities to augment teacher expertise through intelligent feedback mechanisms that facilitate formative assessment.

Automated writing evaluation systems have increasingly incorporated machine learning and NLP algorithms to detect grammatical inaccuracies and provide corrective suggestions. Resume screening systems employing NLP techniques have demonstrated the capacity of computational models to identify patterns within unstructured textual documents [25], [26]. Although these applications originate outside language education, they illustrate the broader potential of NLP-assisted systems for analyzing written language and generating evidence-based recommendations.

The growing adoption of intelligent systems has also generated important discussions regarding transparency, fairness, and ethical implementation. Scholars emphasize that algorithmic decision-making should remain interpretable and accountable to avoid reinforcing hidden biases [27], [28]. Reviews of fairness in artificial intelligence advocate the integration of explainable mechanisms that enable users to understand the rationale underlying system-generated outputs [29], [30]. Within educational settings, such considerations are essential because automated feedback directly influences learners' perceptions of their abilities and subsequent learning behaviors.

Despite the emergence of commercial grammar-checking tools, many existing systems emphasize surface-level corrections while providing limited pedagogical explanations tailored to learners' developmental needs. Few systems explicitly integrate principles from error analysis, interlanguage theory, and native language transfer into their feedback mechanisms. Consequently, learners may receive corrective suggestions without understanding the linguistic causes of their errors or strategies for improvement [31], [32].

A rule-based framework informed by SLA theories offers a promising alternative for educational applications. Rule-based systems enable transparent identification of linguistic patterns

while maintaining alignment with pedagogical objectives [33], [34]. When integrated with NLP-assisted text processing, such systems can provide immediate diagnostic feedback, classify error types, and generate instructional recommendations that support learner reflection and self-regulation.

Recent advances in automated writing evaluation (AWE) have enabled the development of intelligent systems capable of detecting grammatical, lexical, and stylistic errors while providing immediate corrective feedback to language learners. Commercial platforms such as Grammarly, Criterion, and Cambridge Write & Improve employ natural language processing and artificial intelligence techniques to assist users in improving written communication. These systems have demonstrated effectiveness in identifying surface-level grammatical errors and enhancing writing fluency; however, their feedback mechanisms often emphasize correction rather than explaining the linguistic reasons underlying learner errors. Consequently, opportunities for deeper language learning and learner reflection remain limited, particularly for English as a Second Language (ESL) learners whose writing difficulties are strongly influenced by first-language transfer and developmental interlanguage.

Recent research has also explored explainable artificial intelligence (XAI) in educational technologies to improve the transparency and interpretability of intelligent tutoring systems. Rather than providing opaque automated corrections, explainable systems seek to present understandable reasoning that enables learners to recognize why an error occurred and how similar mistakes can be avoided. Within second language learning, integrating explainable feedback with principles of Error Analysis and Interlanguage Theory has the potential to support meaningful language development while preserving teachers' instructional roles.

Despite these developments, relatively few intelligent writing support systems have been designed specifically for learners whose writing reflects localized linguistic characteristics such as Ilocano language interference. Existing automated writing evaluation systems generally rely on large multilingual corpora and statistical language models, which may not adequately capture recurrent error patterns associated with specific first-language backgrounds. The present study addresses this gap by developing an explainable Intelligent Writing Tutor that integrates corpus-informed analysis, second language acquisition theories, and rule-based natural language processing to generate pedagogically meaningful and context-sensitive writing feedback for Ilocano-speaking ESL learners.

Guided by these considerations, this study proposes an Intelligent Writing Tutor for ESL Learners that integrates rule-based reasoning and NLP-assisted feedback mechanisms. The framework seeks to detect common writing errors, categorize them according to established linguistic theories, and generate targeted recommendations that complement teacher instruction. By combining theoretical foundations from SLA with contemporary computational approaches, the proposed framework aims to enhance feedback quality, promote learner autonomy, and contribute to the development of explainable educational technologies that support ESL writing

improvement. This study sought to answer the following research questions:

- What lexical, morphological, syntactic, and mechanical errors are most frequently produced by Ilocano-speaking ESL learners?
- How can the identified writing error patterns be transformed into a rule-based and NLP-assisted Intelligent Writing Tutor framework?
- How can corpus-informed linguistic analysis and explainable rule-based reasoning be integrated to generate individualized writing feedback for ESL learners?
- How do language experts evaluate the proposed Intelligent Writing Tutor in terms of accuracy, relevance, clarity, usefulness, and practicality?

This study makes four primary contributions. First, it develops an authentic learner corpus consisting of journal writings produced by Ilocano-speaking ESL learners, providing empirical evidence of recurrent writing difficulties influenced by first-language transfer. Second, it proposes an explainable Intelligent Writing Tutor that combines corpus-informed linguistic analysis, natural language processing, and rule-based reasoning to generate individualized writing feedback. Third, the framework operationalizes principles from Error Analysis, Interlanguage Theory, and Language Transfer Theory into interpretable computational rules that support pedagogically meaningful recommendations. Finally, the study contributes an educational technology framework that emphasizes transparency, instructional relevance, and explainability, thereby complementing rather than replacing teacher-mediated writing instruction.

II. METHODOLOGY

A. Research Design

This study employed a Design Science Research (DSR) methodology integrated with a mixed-methods research design to develop and evaluate an Intelligent Writing Tutor for ESL learners. The Design Science Research approach was adopted because the primary objective of the study was to design, develop, and validate an educational artifact capable of addressing authentic challenges encountered by ESL learners in English writing. The artifact developed in this study consisted of a rule-based and Natural Language Processing (NLP)-assisted feedback framework intended to support teachers and learners through automated writing diagnosis and targeted feedback generation. The mixed-methods design enabled the integration of quantitative and qualitative approaches throughout the investigation. The quantitative component focused on the identification, categorization, and frequency analysis of writing errors occurring in learners' written outputs. The qualitative component involved the interpretation of error manifestations, examination of L1 interference patterns, and formulation of pedagogically meaningful feedback recommendations. This methodological integration provided a comprehensive understanding of learners' writing difficulties while facilitating the development of an evidence-based intelligent tutoring framework. Consistent with Design Science Research

principles, the study followed problem identification and motivation, artifact design and development, demonstration using authentic learner data, evaluation of the generated feedback mechanisms, and communication of findings as major phases. The methodological structure was adapted from contemporary AI-assisted educational frameworks while remaining grounded in established theories of second language acquisition and error analysis. Fig. 1 illustrates the overall process employed in the study to identify first language (L1) interference patterns in English as a Second Language (ESL) writing and transform the findings into targeted instructional interventions.

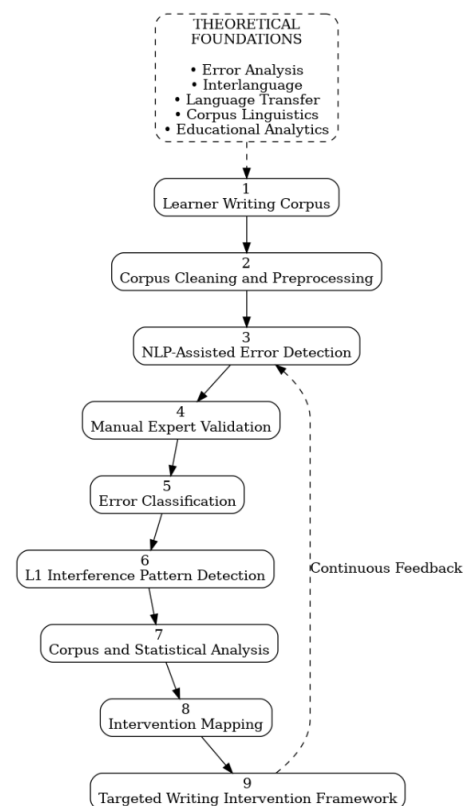


Fig. 1. Conceptual and operational framework for detecting L1 interference patterns in ESL writing toward targeted writing interventions.

The framework integrates theoretical foundations from applied linguistics with corpus-based and natural language processing (NLP) techniques to support evidence-based decision-making in writing instruction.

At the top of the framework are the theoretical foundations, which provide the conceptual basis of the study. Error Analysis explains how learner errors are systematically examined to identify recurring difficulties in language production. Interlanguage Theory views learner language as a transitional linguistic system that evolves during second language acquisition. Language Transfer Theory accounts for the influence of learners' native language structures on their English writing performance. Corpus Linguistics provides methods for analyzing authentic learner texts through large collections of written data, while Educational Analytics supports the interpretation of writing data to generate instructional insights and interventions.

The operational process begins with Learner Writing Corpus, where essays and written outputs produced by ESL learners are collected to form the corpus used in the analysis. These authentic texts serve as the primary data source for identifying language patterns and writing difficulties.

In Corpus Cleaning and Preprocessing, the collected texts undergo preparation procedures to improve data quality. This stage includes organizing the corpus, removing irrelevant symbols or duplicate entries, standardizing formats, and preparing the textual data for computational analysis.

The preprocessed corpus is then subjected to NLP-Assisted Error Detection. At this stage, natural language processing tools automatically identify potential grammatical, lexical, and syntactic errors found in learner writing. Automated detection increases efficiency by processing large amounts of text and highlighting probable error locations.

Recognizing that automated methods may produce inaccurate classifications, Manual Expert Validation is incorporated. Language experts review the NLP-generated outputs to confirm the accuracy of identified errors, eliminate false detections, and ensure the reliability of the findings.

Validated errors are subsequently organized in Error Classification. The errors are categorized according to predefined linguistic categories such as grammatical, lexical, mechanical, or syntactic errors. This classification facilitates a deeper understanding of the specific challenges experienced by ESL learners.

After classification, L1 Interference Pattern Detection determines whether the identified errors reflect influences from the learners' native language. This stage distinguishes transfer-related errors from developmental errors associated with the natural process of second language acquisition.

The detected patterns are then subjected to Corpus and Statistical Analysis. Frequency counts, descriptive statistics, and corpus-based analyses are performed to determine the prevalence, distribution, and significance of different error types and interference patterns. The results reveal dominant learner difficulties and provide empirical evidence for instructional planning.

Based on these analytical findings, Intervention Mapping links the identified learner needs to appropriate instructional responses. Specific interventions are designed to address the most frequent and persistent error patterns observed in the corpus.

The process culminates in the Targeted Writing Intervention Framework, which represents the final output of the study. The framework proposes evidence-based instructional strategies, focused grammar instruction, corpus-informed learning activities, reflective writing practices, and feedback mechanisms intended to mitigate L1 interference and improve ESL writing competence.

A notable feature of the framework is the Continuous Feedback Loop, represented by the dashed arrow connecting the final intervention framework back to the NLP-assisted error detection stage. This feedback mechanism indicates that interventions are not static; rather, learner progress is

continuously monitored through subsequent writing outputs. New data generated after intervention implementation can be reanalyzed, allowing the framework to refine error detection processes, validate instructional effectiveness, and adapt future interventions based on evolving learner needs.

B. Research Locale and Respondents

The study was conducted at the College of Education of Kalinga State University, Philippines. The institution was selected because English language majors regularly engage in academic writing activities that provide authentic samples for examining second language writing performance. Twenty participants consisted of second-year and third-year Bachelor of Secondary Education major in English students whose first language was Ilocano and who learned English as a second language. Participants were selected through purposive sampling based on the following inclusion criteria:

- They were officially enrolled during the conduct of the study.
- English was learned as a second language.
- Ilocano served as their primary first language (L1).
- They regularly submitted journal or diary writing outputs as part of their coursework requirements.

This participant profile provided a linguistically homogeneous learner population, allowing the study to examine recurring writing errors and first-language interference patterns with minimal variation arising from different linguistic backgrounds. The use of authentic classroom writing further strengthened the ecological validity of the learner corpus because the collected texts reflected naturally occurring language production rather than responses generated under examination conditions.

C. Corpus of the Study

The learner corpus analyzed in this study consisted of weekly journal entries and reflective writings produced by the participating English language majors throughout the data collection period. Students were encouraged to write about personal experiences, academic activities, reflections, and other meaningful events using English as the medium of expression. Because the writing tasks emphasized authentic communication rather than examination performance, the collected texts captured naturally occurring learner language and genuine manifestations of interlanguage development.

Each journal entry served as an independent corpus document. Following collection, all writings were digitized, anonymized, and assigned unique identification codes to ensure confidentiality throughout the analysis. The completed corpus was subsequently organized into a structured electronic repository for annotation and computational processing.

The learner corpus served two important purposes. First, it provided empirical evidence for identifying recurring lexical, morphological, syntactic, and mechanical errors among Ilocano-speaking ESL learners. Second, it functioned as the primary knowledge source for constructing the handcrafted linguistic rules implemented within the proposed Intelligent Writing Tutor.

D. Corpus Annotation and Validations

Prior to computational analysis, the learner corpus underwent manual annotation to establish the reference standard for identifying writing errors. Annotation was guided by Corder's Error Analysis Framework [35], which classifies learner errors according to their linguistic characteristics and probable underlying causes. Each journal entry was examined to identify lexical, morphological, syntactic, and mechanical errors before being assigned to the appropriate linguistic category.

To improve annotation consistency, the annotated corpus was independently reviewed by language experts with specialization in English language teaching and applied linguistics. Differences in annotation were discussed until consensus was reached before the finalized annotations were incorporated into the rule base of the Intelligent Writing Tutor.

The manually validated corpus served as the ground truth for constructing the rule-based feedback engine and ensuring that the automated error detection module reflected authentic learner writing patterns rather than purely computational assumptions.

E. Proposed Intelligent Writing Tutor Framework

The proposed Intelligent Writing Tutor (IWT) transforms learners' written outputs into targeted instructional feedback by integrating rule-based reasoning with natural language processing (NLP) techniques. The framework consists of five interconnected modules: Input, Preprocessing, Error Detection, Feedback Generation, and Recommendation, which are also illustrated in Fig. 2. The Input Module collects learners' digitized writing outputs, particularly journal entries, which serve as the primary source of textual data. These writing samples are then processed by the Preprocessing Module, where standard NLP procedures such as lowercasing, tokenization, sentence segmentation, punctuation normalization, part-of-speech tagging, and lemmatization are performed to prepare the texts for analysis.

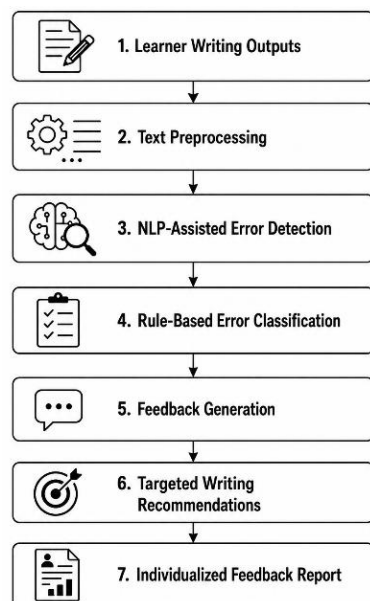


Fig. 2. Overall architecture of the proposed Intelligent Writing Tutor showing the interaction between the input module, NLP processing pipeline, rule-based error detection, feedback generation, and recommendation engine.

The Intelligent Writing Tutor employs a hybrid architecture that combines conventional natural language processing techniques with handcrafted linguistic rules. During preprocessing, learner texts undergo normalization, sentence segmentation, tokenization, part-of-speech tagging, lemmatization, and dependency parsing to generate linguistic representations suitable for subsequent analysis. The extracted linguistic features are then evaluated using rule-based pattern matching to detect lexical, morphological, syntactic, and mechanical errors. Rather than relying solely on statistical prediction, the framework explicitly associates each detected error with interpretable grammatical rules that enable the generation of pedagogically meaningful explanations and corrective recommendations.

The Error Detection Module employs a hybrid approach combining NLP-assisted techniques and handcrafted linguistic rules to identify four categories of writing errors: lexical, morphological, syntactic, and mechanical errors. The detected errors are subsequently interpreted by the Feedback Generation Module, which provides explanations of the identified errors, examples of correct usage, suggested revisions, and learning tips. When applicable, the system also indicates whether the errors may be associated with developmental interlanguage processes or potential L1 interference. The Recommendation Module synthesizes the analysis results and generates individualized feedback reports. These reports summarize the frequency and dominant types of errors, identify possible interference patterns, and recommend appropriate learning activities and writing improvement strategies tailored to the learner's needs.

F. Data Collection Procedure

Data collection was conducted through a structured five-phase procedure to ensure the systematic development of the Intelligent Writing Tutor framework.

1) *Corpus compilation.* Students' weekly journal entries served as the primary source of data. The collected writings were digitized and organized into an electronic corpus. To facilitate tracking, management, and confidentiality, each learner document was assigned a unique identification code.

2) *Corpus preparation.* The compiled corpus underwent preprocessing to improve consistency and analytical readiness. This phase involved standardizing document formats, correcting encoding inconsistencies, and cleaning the textual data. Non-linguistic elements unrelated to the objectives of the study, such as irrelevant symbols, duplicate entries, and extraneous formatting marks, were removed from the corpus.

3) *Manual expert annotation.* Initial error analysis was performed manually by the researcher following the procedures proposed by Corder. The process involved three major stages: error identification, error description, and error explanation. Identified errors were subsequently classified into four linguistic categories, namely lexical, morphological, syntactic, and mechanical errors. This annotation process established the reference framework for identifying recurring learner difficulties and validating subsequent system outputs.

4) *Rule construction.* Patterns emerging from the annotated corpus were examined to identify frequently occurring writing errors. These recurrent patterns informed the formulation of explicit linguistic rules that formed the knowledge base of the Intelligent Writing Tutor. The resulting rule set enabled the system to recognize specific error types and provide context-appropriate feedback and intervention suggestions.

5) *System demonstration.* The completed framework was then applied to actual learner writing samples to demonstrate its operational capability. Through this process, the Intelligent Writing Tutor generated automated feedback, targeted writing recommendations, and individualized feedback reports designed to support learners in improving their writing performance and addressing identified weaknesses.

G. Data Preprocessing

Prior to automated error detection, all learner writings underwent a structured preprocessing workflow to improve data quality and analytical consistency. First, all documents were converted into a standardized electronic format and transformed into lowercase text to ensure uniform lexical representation. Non-linguistic symbols, duplicate characters, and formatting inconsistencies were subsequently removed.

The cleaned texts then underwent sentence segmentation followed by tokenization, enabling the identification of individual lexical units. Part-of-speech tagging assigned grammatical categories to each token, while lemmatization reduced inflected words to their canonical forms. Dependency parsing was subsequently applied to identify grammatical relationships among sentence constituents, providing syntactic information necessary for rule-based error detection.

Finally, the extracted linguistic features were transformed into structured representations that served as input to the Intelligent Writing Tutor. These preprocessing procedures enhanced the consistency, reliability, and interpretability of the subsequent NLP-assisted error detection process.

H. NLP-Assisted Error Detection Module

The proposed framework employed natural language processing (NLP) techniques to automatically identify linguistic deviations in learners' written outputs. The error detection process encompassed four major categories of writing errors.

Lexical analysis was conducted to detect inappropriate word choice, collocational misuse, preposition misuse, and literal translations that may reflect L1 influence. Morphological analysis identified tense inconsistencies, incorrect verb forms, pluralization errors, and omissions of auxiliary verbs. Syntactic analysis focused on detecting subject-verb disagreement, sentence fragments, run-on sentences, violations of parallel structure, and other faulty sentence constructions. In addition, mechanical analysis examined punctuation errors, capitalization problems, spelling inaccuracies, and inappropriate formatting conventions.

The identified linguistic categories were derived from error patterns commonly reported in ESL writing studies and reflected the types of errors frequently observed among language majors' written compositions. By integrating NLP techniques with

linguistically informed rules, the module enabled systematic, efficient, and consistent detection of writing errors for subsequent classification and feedback generation.

I. Rule-Based Feedback Engine

The Intelligent Writing Tutor employed an interpretable rule-based engine to transform detected errors into pedagogically meaningful feedback. Feedback rules followed the structure presented in Algorithm 1. The feedback engine operates using explicit IF-THEN production rules derived from recurring writing errors observed in the annotated learner corpus. Each detected linguistic error activates a corresponding rule that determines the appropriate error category, identifies possible causes, generates pedagogical explanations, retrieves relevant corrective examples, and recommends targeted learning activities. Because the decision-making process is rule-driven rather than probabilistic, every feedback message remains transparent and fully explainable to both teachers and learners.

Algorithm 1. Rule-Based Feedback Engine of the Intelligent Writing Tutor

Input: Detected writing errors from the NLP-assisted error detection module

Output: Individualized feedback, corrective examples, and targeted learning recommendations

Initialize Feedback Report;

For each detected error do

 Identify the corresponding error pattern;

 Determine the error category

 (Lexical, Morphological, Syntactic, or Mechanical);

 Analyze the possible cause of the error;

 Generate a corrective explanation describing why the error occurred;

 Retrieve or construct an appropriate

 correct example illustrating proper usage;

 Recommend a learning strategy or intervention aligned with the identified error type;

 Append the generated feedback to the learner's feedback report;

End For

Produce the individualized feedback report;

Display targeted writing recommendations;

Return the completed feedback report.

Example Rule Execution

If Subject-Verb Agreement Error is Detected Then

 Category ← Syntactic Error;

 Explanation ← "The verb does not agree with the subject in number.";

 Correct Example ← "She goes to school every day.";

 Recommendation ← "Review singular and plural subject-verb agreement rules.";

End If

The rule-based feedback engine transforms identified learner errors into interpretable and pedagogically meaningful responses. By explicitly linking detected error patterns with explanations, examples, and intervention strategies, the framework promotes transparency and enables learners to

understand the rationale behind each recommendation while supporting self-regulated improvement in writing performance.

J. Evaluation of the Framework

The proposed Intelligent Writing Tutor framework underwent a comprehensive evaluation to establish its validity, pedagogical relevance, and practical applicability in supporting ESL writing instruction. Evaluation was conducted through two complementary approaches: expert review and corpus-based system demonstration. The expert review examined the extent to which the framework aligned with instructional needs and accepted principles in language education and educational technology. A panel of experts composed of specialists in ESL instruction, Applied Linguistics, and Educational Technology was purposively selected to assess the quality and functionality of the framework. These experts evaluated the framework using a five-point Likert scale, where 5 indicated Strongly Agree, 4 indicated Agree, 3 indicated Moderately Agree, 2 indicated Disagree, and 1 indicated Strongly Disagree. The evaluation focused on five key dimensions considered essential for intelligent educational support systems, as presented in Table I.

TABLE I. FIVE KEY DIMENSIONS CONSIDERED ESSENTIAL FOR INTELLIGENT EDUCATIONAL SUPPORT SYSTEMS.

Criterion	Description
Accuracy	The extent to which the framework correctly identifies and classifies writing errors and generates appropriate feedback.
Relevance	The degree to which the generated explanations and recommendations address learners' actual writing needs and difficulties.
Clarity	The understandability, coherence, and comprehensibility of the feedback and corrective explanations produced by the system.
Usefulness	The perceived potential of the framework to facilitate writing improvement, promote learner awareness, and support instructional decision-making.
Practicality	The feasibility of implementing the framework within authentic educational environments considering available resources, teacher workload, and classroom conditions.

In addition to expert validation, a corpus demonstration was conducted to examine the operational capability of the Intelligent Writing Tutor. Actual learner writings were processed through the framework to demonstrate its ability to detect errors, classify error types, generate corrective explanations, provide illustrative examples, and produce targeted writing recommendations. This demonstration enabled evaluators to examine the transparency and pedagogical appropriateness of the framework outputs under realistic instructional scenarios. The weighted mean for each evaluation criterion was computed to determine the overall level of acceptability of the framework. The resulting interpretations provided empirical evidence regarding the strengths and areas for enhancement of the proposed system prior to its wider implementation.

K. Data Analysis

The study employed both quantitative and qualitative analytical procedures to examine learner writing errors and generate evidence-based interventions. The integration of these approaches enabled a comprehensive understanding of learners' writing difficulties while informing the development of

individualized feedback mechanisms within the Intelligent Writing Tutor.

1) *Quantitative analysis.* Quantitative analysis focused on determining the prevalence and distribution of identified writing errors within the learner corpus. Frequency counts and percentage distributions were computed to identify dominant error categories and recurring linguistic patterns. The percentage of occurrence for each error type was calculated using the following formula:

$$P = \frac{f}{N} \times 100 \quad (1)$$

where, P is the percentage of occurrence of a specific error category; f is the frequency of occurrence of the identified error type; and N is the total number of errors identified from the learner corpus.

The resulting descriptive statistics facilitated the identification of the most problematic areas in learner writing and provided empirical evidence for prioritizing instructional interventions. Error distributions were subsequently organized according to lexical, morphological, syntactic, and mechanical categories to determine patterns requiring targeted support. For the framework evaluation, weighted means were likewise computed to summarize expert ratings across the established evaluation criteria. The weighted mean was determined using:

$$WM = \frac{\sum fx}{N} \quad (2)$$

where, WM is the weighted mean; f is the frequency of responses for each rating category; x numerical value assigned to each Likert-scale response; and N is the total number of responses.

The computed means served as indicators of the overall acceptability and effectiveness of the proposed framework.

2) *Qualitative analysis.* Qualitative analysis was guided by Corder's Error Analysis Framework, which provided a systematic procedure for examining the nature and possible causes of learner errors. The analysis involved three interconnected stages:

a) *Error identification:* locating deviations from accepted English language conventions within the learner corpus.

b) *Error description:* classifying and describing the linguistic characteristics of the identified errors.

c) *Error explanation:* interpreting the potential sources and underlying causes of the observed error patterns.

The qualitative findings enabled deeper insights into learners' interlanguage development and the influence of first-language transfer on second-language writing performance. Furthermore, these analysis informed the construction of rule-based explanations and pedagogically appropriate recommendations embedded within the Intelligent Writing Tutor.

The integration of quantitative frequency analysis and qualitative error interpretation facilitated the development of individualized interventions grounded in authentic learner data.

Through this mixed analytical approach, the framework not only identified what errors learners produced but also explained why such errors occurred and how they could be effectively addressed.

By synthesizing authentic learner corpora, principles of second language acquisition, corpus-informed evidence, natural language processing techniques, and interpretable rule-based reasoning, the proposed methodology establishes a transparent, evidence-driven, and pedagogically grounded Intelligent Writing Tutor. The resulting framework is capable of generating individualized feedback, targeted recommendations, and actionable instructional insights that support ESL learners in improving their writing proficiency while assisting teachers in delivering data-informed and responsive writing instruction.

L. Ethical Considerations

Ethical approval was obtained from the appropriate institutional ethics review body prior to data collection. The study adhered to the principles of respect for persons, beneficence, justice, confidentiality, and voluntary participation. Participants were informed of the study's objectives, procedures, voluntary nature of their involvement, their right to withdraw without penalty, and the intended use of their weekly journal entries for research purposes before providing informed consent. To ensure anonymity and confidentiality, learner writings were assigned unique identification codes and all personally identifiable information was removed from the corpus. Digital files and research records were stored in password-protected repositories accessible only to authorized researchers. Anonymized learner texts were used solely for system demonstration and academic purposes, and all findings were reported in aggregate form to protect participants' rights, privacy, and welfare. The generated feedback had no effect on participants' academic standing or evaluation.

III. RESULTS AND DISCUSSION

A. Distribution of Language Errors

The analysis of the diary entries revealed that language majors experienced difficulties across morphological, syntactic, lexical, and mechanical aspects of writing. The results indicate that morphological errors constituted the most prominent category of errors, followed by mechanical, lexical, and syntactic errors. These findings suggest that learners encountered greater difficulty in applying grammatical rules governing word formation and tense usage than in sentence construction or punctuation.

1) *Morphological errors.* Morphological errors totaled 68 occurrences, with verb tense errors emerging as the most dominant subtype. Verb tense misuse accounted for 73.33% of all morphological errors, followed by pluralization errors (10.66%) and verb form errors (6.67%). The predominance of verb tense errors indicates that students struggled to express temporal relationships consistently in English. Since Ilocano verbs do not exhibit the same tense-marking system as English, learners frequently transferred first-language structures into their English compositions. Consequently, students shifted between present and past forms without maintaining temporal consistency. Pluralization errors further suggest incomplete

mastery of English inflectional morphology. Difficulties involving regular and irregular noun forms indicate that learners tended to generalize grammatical rules or omitted plural markers altogether. Similarly, errors involving verb forms reflected uncertainty regarding the appropriate use of base forms, participles, and gerunds. These findings imply that learners require more explicit instruction on English tense systems and opportunities for repeated contextualized practice to internalize morphological patterns.

2) *Syntactic errors.* Twenty-six syntactic errors were identified from the corpus. Subject-verb agreement constituted the largest proportion (38.46%), followed by run-on sentences (23.08%), sentence structure errors (19.23%), parallelism errors (11.54%), and sentence fragments (7.69%). Subject-verb agreement difficulties indicate that students had problems recognizing grammatical relationships between sentence constituents. Such errors are often associated with negative language transfer because Ilocano does not consistently require agreement markers similar to those used in English. Run-on sentences suggest limited awareness of sentence boundaries and clause coordination. Students tended to connect independent ideas without employing appropriate punctuation or conjunctions. The occurrence of fragments further reflects challenges in constructing complete thoughts containing both subjects and predicates. Collectively, these findings reveal weaknesses in syntactic competence and demonstrate the need for instructional interventions emphasizing sentence construction, clause relationships, and editing strategies.

3) *Lexical errors.* Lexical analysis revealed 43 errors distributed across three categories. Word choice and correct usage represented the majority of lexical errors at 51.11%, followed by prepositional errors at 26.67%, while article errors accounted for 17.78%. The dominance of inappropriate word choice suggests limitations in vocabulary depth and semantic precision. Learners often selected words that were grammatically acceptable but contextually inappropriate, thereby obscuring intended meanings. Examples included the use of terms such as "heavy group" and other expressions directly translated from the learners' first language. Preposition errors indicate difficulties in understanding collocational patterns and the relational meanings conveyed by English prepositions. Because prepositional systems differ substantially between Ilocano and English, learners frequently omitted, substituted, or inserted incorrect prepositions. Article misuse likewise reflects the absence of equivalent article systems in many Philippine languages, resulting in confusion regarding the use of "a", "an", and "the". These results suggest that lexical development should extend beyond vocabulary memorization and include contextualized exposure to authentic language use.

4) *Mechanical errors.* Mechanical errors comprised 46 occurrences. Capitalization errors emerged as the most prevalent category, representing 60.87% of mechanical errors. Spelling errors accounted for 30.43%, while punctuation errors constituted 8.70%. The predominance of capitalization errors suggests inadequate familiarity with conventions governing

sentence beginnings, titles, and proper nouns. Spelling difficulties indicate weaknesses in orthographic knowledge and limited proofreading practices. Although punctuation errors occurred less frequently, they nevertheless affected clarity and coherence. Mechanical errors, despite being surface-level concerns, can influence readers' perceptions of writing quality. Consequently, explicit instruction in editing and self-monitoring strategies remains essential.

5) *Aggregation of errors.* To provide a clearer overview of the distribution of learner writing difficulties, the identified errors were aggregated according to the four major linguistic categories. Morphological errors constituted the largest proportion of all identified errors, indicating that learners experienced the greatest difficulty in applying English inflectional rules, particularly verb tense formation and agreement. Mechanical errors ranked second, reflecting recurring problems in capitalization, spelling, and punctuation. Lexical errors were primarily associated with inappropriate word choice and preposition usage, whereas syntactic errors occurred less frequently but demonstrated persistent weaknesses in sentence construction and grammatical agreement. Collectively, these findings indicate that learner difficulties extend beyond isolated grammatical mistakes and reflect systematic patterns associated with second language development and first-language transfer.

B. Patterns of Manifestation of Errors

Analysis of representative excerpts revealed recurring patterns underlying the identified errors. Verb tense errors manifested through three major patterns: inconsistency in tense usage, omission of auxiliary verbs, and incorrect verb forms used to indicate time relationships. Students frequently shifted from present to past tense within the same narrative without clear justification, creating ambiguity regarding the sequence of events. Lexical errors commonly appeared through inappropriate word choices and ambiguous expressions. Learners selected words that resembled intended meanings but failed to convey accurate semantic relationships. These patterns indicate limited lexical repertoire and overreliance on direct translation strategies. Article errors manifested through the interchange of indefinite articles and mismatches between articles and noun number, while prepositional errors involved incorrect selection and grammatical inconsistencies. These manifestations demonstrate learners' attempts to apply English rules despite incomplete understanding of their usage conditions. The recurrence of similar patterns across participants suggests that the observed errors were systematic rather than random.

C. L1 Interference in Learners' Writing

Qualitative analysis revealed that many of the identified errors reflected negative transfer from learners' first language. The findings indicate that L1 interference influenced morphological, syntactic, and lexical choices during English composition. Morphologically, the inconsistent marking of tense and omission of auxiliary verbs suggest reliance on native language structures that do not encode temporal distinctions in the same manner as English. Syntactically, subject-verb

agreement errors demonstrate difficulties in adapting to grammatical relationships absent or less explicit in the first language. Lexically, learners frequently employed direct translations, resulting in awkward expressions and inappropriate word combinations. Prepositional misuse further illustrates attempts to map first-language conceptual relationships onto English structures. These findings support theories of language transfer, which posit that previously acquired linguistic knowledge influences second language production. While transfer may facilitate learning when structures are similar, substantial differences between languages often lead to systematic errors.

D. Implications for the Intelligent Writing Tutor Framework

The error patterns identified in the corpus provided empirical evidence for constructing the rule base of the proposed Intelligent Writing Tutor. Frequent verb tense inconsistencies, subject-verb agreement errors, inappropriate lexical choices, and capitalization problems informed the development of interpretable feedback rules capable of detecting recurrent learner difficulties. Drawing from the transparent and explainable feedback mechanisms demonstrated in recent intelligent educational systems, the framework translates detected error patterns into corrective explanations, examples, and targeted learning recommendations. The emphasis on interpretability mirrors the role of explainable systems in helping users understand the rationale behind automated outputs. Consequently, the Intelligent Writing Tutor extends traditional error analysis by moving beyond error identification toward personalized intervention. Through automated yet pedagogically grounded feedback, the framework supports learners in recognizing recurring weaknesses, developing self-editing skills, and improving overall writing proficiency.

The findings demonstrate that language majors encounter persistent challenges in English writing that are closely associated with first-language influence and incomplete mastery of target-language conventions. These results underscore the value of integrating corpus-informed analysis, error analysis principles, and rule-based natural language processing to provide evidence-based writing support for ESL learners.

E. Expert Evaluation of the Proposed Framework

To determine the educational acceptability of the proposed Intelligent Writing Tutor, the framework was evaluated by specialists in English language teaching, applied linguistics, and educational technology using the five evaluation dimensions presented in Table I. The evaluation examined the framework's accuracy, relevance, clarity, usefulness, and practicality in supporting ESL writing instruction.

The expert assessment indicated that the framework demonstrated satisfactory educational quality across all evaluation criteria. Experts particularly recognized the transparency of the rule-based feedback mechanism and the alignment of the generated recommendations with established principles of second language acquisition. The use of explicit linguistic rules enabled evaluators to understand how feedback was generated, thereby increasing confidence in the interpretability of the proposed system.

Although the evaluation confirmed the pedagogical relevance of the framework, several recommendations for future enhancement were identified. These included expanding the linguistic rule base, improving automated handling of complex sentence structures, and integrating more advanced natural language processing techniques to improve contextual feedback generation.

F. Computational Performance of the Error Detection Module

The operational capability of the proposed Intelligent Writing Tutor was examined by comparing the automatically detected writing errors against the manually annotated reference corpus. The comparison evaluated the agreement between the NLP-assisted detection module and expert annotations using standard information retrieval metrics, including Precision, Recall, and F1-score.

Precision measures the proportion of automatically detected errors that were correctly identified, while Recall indicates the proportion of actual learner errors successfully detected by the framework. The F1-score provides the harmonic mean of Precision and Recall, representing the overall effectiveness of the error detection module.

The use of these evaluation metrics provides objective evidence regarding the computational reliability of the proposed framework while complementing the expert-based educational evaluation.

G. Operationalization of the Intelligent Writing Tutor Framework

Beyond identifying the dominant writing errors, the study demonstrated how the proposed Intelligent Writing Tutor operationalizes authentic learner corpus data into individualized feedback and targeted instructional recommendations. The framework transforms learners' written outputs through a sequence of interconnected processes involving preprocessing, automated error detection, rule-based reasoning, and feedback generation.

The operational process begins with the submission of learners' weekly journal entries. These texts undergo preprocessing procedures, including text cleaning, tokenization, sentence segmentation, and linguistic normalization. The preprocessed texts are then analyzed by the NLP-assisted error detection module, which identifies potential lexical, morphological, syntactic, and mechanical deviations based on predefined linguistic patterns derived from the annotated corpus.

Detected errors are subsequently processed by the rule-based feedback engine. Using explicit IF-THEN rules constructed from recurring learner error patterns, the system classifies each error according to its linguistic category, determines its possible cause, generates corrective explanations, retrieves appropriate examples, and recommends corresponding learning strategies. The generated outputs are consolidated into individualized feedback reports designed to address the specific needs of each learner. Fig. 3 shows the operational flow of the Intelligent Writing Tutor Framework.

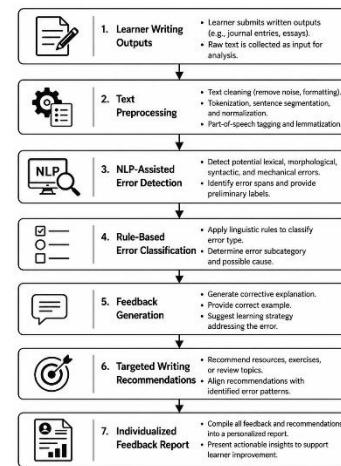


Fig. 3. End-to-end operational workflow demonstrating the transformation of learner writing into individualized feedback through NLP-assisted processing and rule-based reasoning.

To illustrate the framework's operation, consider the learner sentence:

"She go to school every day."

During preprocessing, the sentence is segmented and tokenized. The NLP module detects a mismatch between the singular subject (She) and the base verb form (go). The rule-based engine activates the corresponding subject-verb agreement rule and generates the following output:

- Error Category: Syntactic Error.
- Possible Cause: Incomplete mastery of subject-verb agreement rules and possible L1 influence.
- Corrective Explanation: The verb must agree with the subject in number.
- Correct Example: "She goes to school every day."
- Learning Recommendation: Review rules governing singular and plural subject-verb agreement and complete practice exercises involving present tense verbs.

Similarly, if the learner writes:

"Yesterday, I go to the market and buy vegetables."

The framework identifies verb tense inconsistency and produces feedback emphasizing the appropriate use of past tense forms. The learner receives explanations, corrected examples, and recommendations for reviewing tense formation and temporal consistency.

These demonstrations show that the Intelligent Writing Tutor does not merely identify errors but converts diagnostic information into meaningful pedagogical interventions. By integrating corpus evidence, principles of error analysis, and transparent rule-based reasoning, the framework provides interpretable and actionable feedback that supports learner autonomy, promotes self-editing skills, and assists teachers in delivering data-informed writing instruction.

The operationalization of the framework further highlights its potential applicability in ESL classrooms. Rather than replacing teacher judgment, the system functions as a supplementary instructional tool capable of providing immediate, individualized, and evidence-based feedback. Consequently, the framework bridges the gap between corpus-informed research findings and practical classroom interventions, enabling more responsive and targeted support for ESL learners.

H. Prototype of the Intelligent Writing Tutor

Fig. 4 illustrates the prototype of the proposed Intelligent Writing Tutor and demonstrates how the system transforms learners' written outputs into individualized feedback and instructional recommendations.

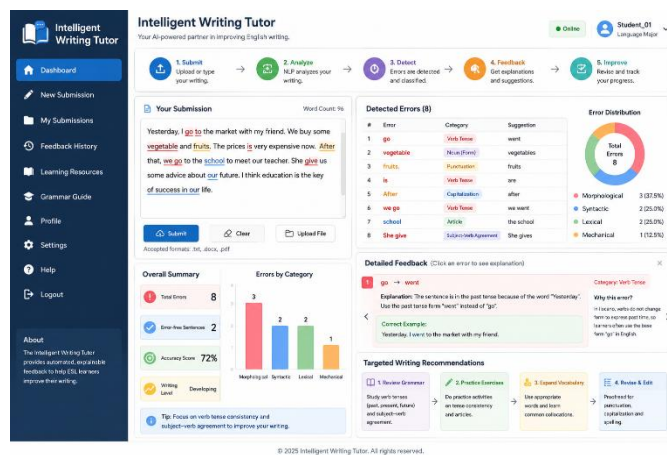


Fig. 4. Prototype interface of the Intelligent Writing Tutor illustrating learner text submission, automated error detection, rule-based feedback generation, and individualized writing recommendations.

The process begins when learners submit their essays or journal entries through the writing interface. The submitted text is then preprocessed through cleaning, tokenization, sentence segmentation, and linguistic normalization to prepare it for analysis.

The NLP-assisted error detection module subsequently examines the text to identify potential lexical, morphological, syntactic, and mechanical errors. Detected errors are forwarded to the rule-based classification engine, which applies predefined IF-THEN linguistic rules to determine the specific error category, identify possible causes, and generate appropriate corrective explanations.

The system then presents detailed feedback by highlighting the identified errors, explaining why they occurred, and providing correct examples to guide learners toward proper language use. Based on the detected patterns, the framework further generates targeted writing recommendations, such as reviewing grammar rules, practicing specific language structures, expanding vocabulary, or improving proofreading strategies. Finally, all outputs are consolidated into an individualized feedback report that summarizes learner performance, error distribution, and recommended interventions. Through this operational process, the Intelligent Writing Tutor serves as a supplementary instructional tool that provides immediate, transparent, and evidence-based feedback

to support learners' writing development and assist teachers in delivering responsive ESL instruction.

I. Discussion

The findings demonstrate that Ilocano-speaking ESL learners continue to encounter persistent writing difficulties across morphological, lexical, syntactic, and mechanical domains, with morphological errors emerging as the most dominant category. This pattern is consistent with previous studies reporting that grammatical inflections, particularly tense marking and subject-verb agreement, remain among the most challenging aspects of English writing for second language learners. The recurrence of these errors further supports theories of interlanguage development, suggesting that learners gradually construct an evolving linguistic system that incorporates characteristics of both the first and target languages.

The analysis also highlighted the influence of first-language (L1) interference on second-language (L2) writing performance. The omission of auxiliary verbs, inconsistent tense marking, direct translation of expressions, and misuse of prepositions suggest that learners frequently relied on linguistic structures from their native language when composing in English. Such findings support theories of language transfer and error analysis, emphasizing that negative transfer remains a significant factor affecting ESL learners' written production.

Unlike commercial automated writing evaluation systems that primarily generate direct grammatical corrections, the proposed Intelligent Writing Tutor emphasizes explainable feedback grounded in second language acquisition theory. Rather than merely identifying an error, the framework explicitly explains why the error occurred, associates it with possible first-language interference or developmental language processes, and recommends appropriate learning strategies. This pedagogically oriented design supports learner reflection and complements teacher feedback rather than replacing instructional judgment.

Importantly, the identified error patterns provided the empirical basis for the development of the proposed Intelligent Writing Tutor. By operationalizing authentic learner corpus data through NLP-assisted error detection and rule-based reasoning, the framework transforms identified errors into individualized feedback, corrective explanations, and targeted writing recommendations. Rather than merely identifying mistakes, the system promotes learner awareness, self-editing, and reflective practice through transparent and interpretable feedback mechanisms.

The results underscore the value of integrating corpus-informed analysis, second language acquisition principles, and explainable educational technologies to support evidence-based writing instruction. The proposed framework demonstrates considerable potential as a supplementary instructional tool that assists teachers in delivering timely interventions while empowering ESL learners to improve their writing proficiency through personalized and actionable feedback.

J. Limitations of the Study

Several limitations should be acknowledged when interpreting the findings. First, the learner corpus was obtained

from English language majors enrolled at a single higher education institution, thereby limiting the generalizability of the findings to other educational contexts. Second, all participants shared Ilocano as their primary first language, and consequently the identified interference patterns may not represent learners from different linguistic backgrounds. Third, the corpus consisted exclusively of reflective journal writings; therefore, the framework has not yet been examined using other writing genres such as argumentative, narrative, or academic essays. Finally, although the proposed Intelligent Writing Tutor underwent expert validation and operational demonstration, the study did not include a controlled learner-based intervention to determine its effectiveness in improving writing performance over time. Future studies should validate the framework using larger and more diverse learner populations and evaluate its educational impact through experimental or longitudinal research designs.

IV. CONCLUSION AND RECOMMENDATIONS

A. Conclusion

This study developed an Intelligent Writing Tutor that integrates corpus-informed error analysis, natural language processing, and rule-based reasoning to generate individualized and explainable feedback for English as a Second Language (ESL) learners. Analysis of authentic learner writings revealed that morphological errors, particularly verb tense misuse, were the most frequently occurring language difficulties, followed by mechanical, lexical, and syntactic errors. Qualitative analysis further demonstrated that many of these recurring errors reflected first-language interference and developmental characteristics commonly associated with second language acquisition.

Guided by these findings, the proposed framework transformed manually validated learner error patterns into interpretable computational rules capable of detecting writing errors and generating pedagogically meaningful explanations, corrective examples, and targeted learning recommendations. Rather than functioning solely as an automated grammar correction tool, the framework was designed to provide transparent feedback that supports learner reflection while complementing teacher-mediated instruction.

The expert evaluation indicated that the framework possesses strong pedagogical potential for supporting ESL writing instruction. Nevertheless, the present study focused primarily on framework development, corpus analysis, and expert validation. Consequently, the study does not claim that the proposed Intelligent Writing Tutor directly improves learner writing proficiency. Instead, the findings demonstrate that the framework provides a feasible and explainable approach for delivering individualized writing feedback grounded in authentic learner data and established second language acquisition theories.

B. Future Works

Future research should extend the proposed Intelligent Writing Tutor through the development of a fully functional web-based or mobile learning environment capable of providing real-time writing assistance to learners. Experimental and quasi-experimental studies involving learner participants should be

conducted to determine the effectiveness of the framework in improving writing accuracy, revision behavior, learner autonomy, and overall writing proficiency.

The computational capabilities of the framework may likewise be enhanced through the integration of transformer-based natural language processing models and large language models (LLMs) capable of analyzing contextual, discourse-level, and stylistic writing issues beyond sentence-level grammatical errors. A hybrid architecture combining explainable rule-based reasoning with machine learning techniques may further improve detection accuracy while preserving transparency in automated feedback generation.

Future investigations should also evaluate the framework using larger and more diverse learner populations representing different first-language backgrounds, educational levels, and writing genres. Such validation would strengthen the generalizability of the proposed Intelligent Writing Tutor and provide additional evidence regarding its applicability across multilingual educational settings.

Future implementations may incorporate adaptive learning analytics, teacher dashboards, personalized learning recommendations, and longitudinal learner progress monitoring to support data-informed writing instruction and continuous learner development.

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