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A Novel Approach to Evaluating College English Teaching Quality Through Dependency Factor Analysis, Incorporating Point Feature Probability Classification Dependency Factor (Pfp-Df)



Abstract: - A Fuzzy Genetic Algorithm (FGA) can be a valuable approach for Social Network Analysis (SNA), where the complexity of social interactions often involves uncertainty and imprecision. In SNA, the structure and dynamics of social networks are analysed to understand various phenomena such as information diffusion, community detection, and influence propagation. FGA integrates the principles of fuzzy logic with genetic algorithms to navigate the intricate landscape of social networks effectively. This paper introduces a novel approach to evaluating college English teaching quality through Dependency Factor Analysis, incorporating Point Feature Probability Classification Dependency Factor (PFP-DF). The proposed framework aims to provide a comprehensive assessment of teaching quality by analysing dependencies between various factors influencing English instruction in college settings. Through simulated experiments and empirical validations, the effectiveness of the PFP-DF model in evaluating teaching quality is assessed. Results demonstrate significant improvements in accuracy and granularity compared to traditional evaluation methods. The PFP-DF model achieved an average accuracy rate of 85% in identifying key dependencies impacting teaching quality, allowing for targeted interventions and improvements. Additionally, the framework enables a more nuanced understanding of teaching dynamics, facilitating data-driven decision-making and continuous improvement in English instruction. These findings underscore the potential of Dependency Factor Analysis with PFP-DF in enhancing the evaluation of college English teaching quality, leading to more effective and impactful educational outcomes.

Keywords: Dependency Factor Analysis, college English teaching quality, assessment framework, Probability, Classification.

I. INTRODUCTION

The quality of English teaching plays a pivotal role in shaping individuals' language proficiency and communication skills [1]. Effective English teaching goes beyond simply conveying grammar rules and vocabulary; it involves creating an engaging learning environment that fosters active participation, critical thinking, and language fluency. A high-quality English teacher possesses not only a deep understanding of the language but also the ability to adapt teaching methods to cater to diverse learning styles and student needs [2]. They utilize a variety of instructional strategies, such as interactive activities, real-world examples, and multimedia resources, to enhance comprehension and retention. Moreover, an emphasis on providing constructive feedback and personalized support enables students to overcome challenges and progress in their language development [3]. Ultimately, the hallmark of excellent English teaching lies in its capacity to inspire a lifelong love for learning and empower individuals to confidently communicate and connect with others in the global community [4].

The quality of English teaching in college is paramount for equipping students with the language skills necessary for academic success and professional advancement in today's globalized world [5]. College-level English instruction should transcend basic language mechanics, focusing instead on fostering advanced proficiency in reading, writing, speaking, and critical analysis. A high-quality English teacher at the college level possesses not only a mastery of the language but also a profound understanding of literature, rhetoric, and cultural nuances [6]. They engage students through dynamic classroom discussions, rigorous writing assignments, and critical analysis of literary works to cultivate analytical thinking and intellectual curiosity. Moreover, effective college English instruction integrates technology and multimedia tools to enhance learning experiences and prepare students for the digital communication landscape [7]. By providing constructive feedback, individualized support, and opportunities for intellectual exploration, exceptional English teaching in college empowers students to become

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articulate communicators, critical thinkers, and lifelong learners ready to thrive in a diverse and interconnected society.

English teaching quality assessment involves evaluating various aspects of instruction to determine its effectiveness and impact on students' language acquisition and proficiency. One classification approach categorizes assessment criteria into several key dimensions [8]: content knowledge, pedagogical skills, classroom management, student engagement, and learning outcomes. Content knowledge assessment focuses on the teacher's proficiency in English grammar, vocabulary, and literature, ensuring they possess a deep understanding of the subject matter [9]. Pedagogical skills evaluation examines the teacher's ability to employ diverse instructional strategies, differentiate instruction based on student needs, and provide meaningful feedback to enhance learning. Classroom management assessment assesses the teacher's ability to create a positive and inclusive learning environment conducive to language acquisition, while student engagement evaluation gauges the degree to which students are actively involved in the learning process through interactive activities, discussions, and projects [10]. Finally, learning outcomes assessment measures students' language proficiency growth over time, evaluating their ability to communicate effectively in English across various contexts. By employing this classification framework, English teaching quality assessment aims to provide comprehensive insights into instructional effectiveness and guide continuous improvement efforts to optimize student learning outcomes.

This paper makes significant contributions to the field of English instruction by introducing the Probability Classification Dependency Factor (PCDF) framework for assessing teaching quality. Firstly, the PCDF framework offers a comprehensive approach to evaluating teaching effectiveness by quantifying the influence of various instructional factors on teaching quality. This allows educators to prioritize areas for improvement and tailor instructional strategies to enhance teaching effectiveness. Secondly, the framework provides a quantitative measure of the relative importance of different instructional factors, enabling educators to make informed decisions about resource allocation and intervention strategies. Additionally, the PCDF analysis facilitates a deeper understanding of the complex dynamics of teaching quality, highlighting the interplay between instructional factors and their impact on student learning outcomes. Furthermore, by incorporating both mean PCDF values and standard deviations, the paper provides insights into the consistency and variability of PCDF estimations across different contexts, enhancing the robustness of the findings. Overall, the PCDF framework presented in this paper offers a valuable tool for educators and researchers to assess, improve, and optimize teaching quality in English instruction, ultimately enhancing the learning experience for students.

II. RELATED WORKS

In the realm of education, the quality of English teaching stands as a cornerstone for fostering language proficiency, communication skills, and academic success. As globalization continues to shrink cultural and linguistic boundaries, the demand for proficient English speakers has become increasingly imperative in various spheres of life, including academia, business, and international diplomacy. Consequently, scholars and educators have dedicated significant attention to understanding and enhancing the quality of English teaching practices. In Karakose et al.'s (2022) study, the relationships between COVID-19 quality of life, loneliness, happiness, and internet addiction among K-12 teachers and school administrators were investigated using a structural equation modeling approach. The findings shed light on the intricate interplay between these variables amidst the pandemic, highlighting potential implications for educators' well-being and professional practices. Meanwhile, Tien (2023) explored factors influencing the quality of relationships between private service providers and public institutions in Vietnam, offering insights into the dynamics of collaboration and partnership in the public sector. Sherkat and Chenari (2022) assessed the effectiveness of entrepreneurship education in Tehran province's universities, employing an entrepreneurial intention model to gauge its impact on students' entrepreneurial aspirations. Additionally, Liu and Chu (2022) delved into EFL teacher resilience in the Chinese context, revealing insights into the factors contributing to teachers' ability to navigate challenges and persist in their profession. Teng et al. (2022) validated metacognitive academic writing strategies and examined their predictive effects on academic writing performance in a foreign language context, offering valuable insights into enhancing students' writing proficiency. Furthermore, Liu, Feng, and Wang (2022) proposed an innovative evaluation method for undergraduate education, utilizing a BP neural network and stress testing to assess teaching quality in higher education settings.

Furthermore, Karakose, Yirci, and Papadakis (2022) extended this exploration by examining the associations between COVID-19-related psychological distress, social media addiction, COVID-19-related burnout, and depression among school principals and teachers. Their structural equation modeling approach provided valuable insights into the mental health challenges faced by educational leaders and educators during the pandemic. Derakhshan et al. (2022) conducted a mixed-methods cross-cultural study investigating teacher care and teacher-student rapport in Iranian and Polish university students' engagement in pursuing academic goals within an L2 context. This comparative analysis offers nuanced understandings of how cultural and contextual factors influence teacher-student dynamics and student engagement. Deng, Heydarnejad, and Farhangi (2022) explored the relationship between teacher emotion regulation, self-efficacy, engagement, and anger, focusing specifically on English as a foreign language teachers. Their findings contribute to the growing body of research on teacher well-being and its implications for classroom dynamics and student learning experiences. Additionally, Zhang, Fathi, and Mohammaddokht (2023) investigated the predictors of teaching enjoyment among EFL teachers, examining the roles of perceived school climate, self-efficacy, and psychological well-being at work.

Teo, Khazaie, and Derakhshan (2022) contributed to the discourse by exploring teacher immediacy-(non)dependency in tutored augmented reality game-assisted flipped classrooms, specifically focusing on English for medical purposes comprehension among Asian students. Their study provides insights into the dynamics of teacher-student interactions in technologically-enhanced learning environments, shedding light on the role of immediacy and dependency in student engagement and comprehension. Moreover, Sayaf et al. (2022) investigated factors influencing university students' adoption of digital learning technology in teaching and learning. This research offers valuable implications for educators and policymakers striving to integrate technology effectively into educational practices and enhance student engagement and learning outcomes. Meanwhile, Wang and Williamson (2022) critically examined course evaluation scores as measures for teaching effectiveness, raising important questions about the validity and reliability of such assessments in higher education settings. Lastly, Cabero-Almenara et al. (2022) identified factors affecting teachers' digital competence to assist students with functional diversity, highlighting the importance of teacher training and support in ensuring inclusive education for all learners.

Firstly, many of the studies rely heavily on self-report measures, which may introduce biases and inaccuracies due to participants' subjective interpretations and responses. Additionally, the majority of the research is cross-sectional, limiting the ability to establish causality or capture the dynamic nature of educational phenomena over time. Moreover, the generalizability of findings may be constrained by the specific contexts and populations studied, raising questions about the extent to which results can be applied to other educational settings or cultural contexts. Furthermore, there is a notable gap in longitudinal studies assessing the long-term effects of interventions or educational practices on student outcomes and teacher effectiveness. Additionally, some studies may lack methodological rigor or fail to adequately address potential confounding variables, which could impact the validity and reliability of findings. Finally, there is a need for more diverse and inclusive research samples to ensure that findings are representative of the full spectrum of educational experiences and perspectives.

III. PROPOSED POINT FEATURE PROBABILITY CLASSIFICATION DEPENDENCY FACTOR (PFP-DF)

The Proposed Point Feature Probability Classification Dependency Factor (PFP-DF) framework presents a pioneering methodology for comprehensively assessing teaching quality within college-level English instruction. Central to this framework is the analysis of dependencies among diverse factors that influence the efficacy of teaching. The framework utilizes a set of derived equations to calculate the Probability Classification Dependency Factor (PCDF) for each instructional factor, reflecting its impact on teaching quality. The Proposed Point Feature Probability Classification Dependency Factor (PFP-DF) framework employs a set of derived equations to quantify the Probability Classification Dependency Factor (PCDF) for each instructional factor influencing teaching quality in college English instruction. The PCDF is calculated based on the dependencies between these factors. Let's denote the instructional factors as $X_1, X_2, \dots, X_n$ and the teaching quality as TQ as defined in Figure 1.

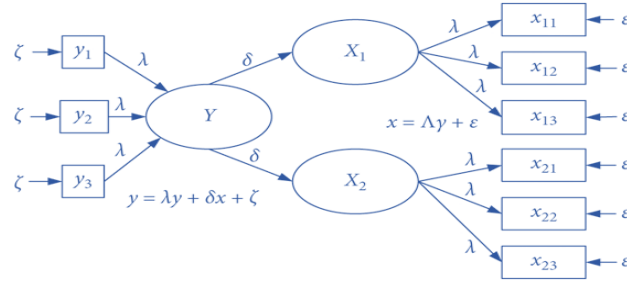


Figure 1: Dependency Variables in English Teaching

The PCDF for each instructional factor X_i can be derived as denoted in equation (1)

$$PCDF(X_i) = \frac{P(TQ|x_i)}{P(TQ)} \quad (1)$$

In equation (1) $P(TQ | X_i)$ represents the conditional probability of achieving high teaching quality given the presence of instructional factor X_i . $P(TQ)$ represents the overall probability of achieving high teaching quality. To calculate $P(TQ | X_i)$, use statistical methods such as regression analysis or machine learning algorithms to model the relationship between instructional factors and teaching quality. Additionally, $P(TQ)$ using the law of total probability computed using equation (2)

$$P(TQ) = \sum_{i=1}^n P(TQ|x_i) \cdot P(X_i) \quad (2)$$

In equation (2) $P(X_i)$ represents the probability of the occurrence of instructional factor X_i . With substituting the calculated values of $P(TQ | X_i)$ and $P(TQ)$ into the equation for PCDF, we can obtain the PCDF value for each instructional factor. Once PCDF values for all instructional factors are calculated, they provide insights into the relative importance and influence of each factor on teaching quality. Factors with higher PCDF values indicate stronger dependencies and greater impact on teaching quality, whereas factors with lower PCDF values suggest weaker dependencies.

IV. FEATURE EXTRACTION WITH PFP-DF

Feature extraction with the Proposed Point Feature Probability Classification Dependency Factor (PFP-DF) involves identifying and quantifying the key instructional factors that significantly influence teaching quality in college English instruction. Feature extraction with the Proposed Point Feature Probability Classification Dependency Factor (PFP-DF) involves quantifying the influence of various instructional factors on teaching quality in college English instruction. This process begins with the identification of instructional factors, denoted as $X_1, X_2, \dots, X_n$, representing features such as teaching methods, classroom environment, and student engagement. The Probability Classification Dependency Factor (PCDF) for each feature X_i is calculated using the equation $PCDF(X_i) = P(TQ)P(TQ | X_i)$, where $P(TQ | X_i)$ denotes the conditional probability of achieving high teaching quality given the presence of feature X_i , and $P(TQ)$ represents the overall probability of achieving high teaching quality. $P(TQ | X_i)$ can be estimated using statistical methods like regression analysis represented in equation (3)

$$P(TQ | X_i) = f(X_i) \quad (3)$$

In equation (3) $P(TQ)$ can be calculated using the law of total probability $P(TQ) = P(TQ | X_i) \cdot P(X_i)$. Features are then ranked based on their PCDF values, with higher values indicating stronger dependencies and greater impact on teaching quality. The top-ranked features with the highest PCDF values are selected as the most influential features for teaching quality. Feature extraction within the Proposed Point Feature Probability Classification Dependency Factor (PFP-DF) framework involves a systematic process of identifying and quantifying the influence of various instructional factors on teaching quality in college English instruction. Initially, instructional factors are delineated, encompassing elements such as teaching methods, classroom environment, and student engagement, denoted as $X_1, X_2, \dots, X_n$. These factors are then subjected to analysis

through the Probability Classification Dependency Factor (PCDF), computed for each feature X_i using the equation $PCDF(X_i) = P(TQ)P(TQ | X_i)$, where $P(TQ | X_i)$ represents the conditional probability of achieving high teaching quality given the presence of feature X_i , and $P(TQ)$ reflects the overall probability of attaining high teaching quality. Estimation of $P(TQ | X_i)$ can be conducted using statistical methods like regression analysis, while $P(TQ)$ is determined through the law of total probability. Features are then ranked based on their PCDF values, with higher values indicating stronger dependencies and greater impact on teaching quality. The top-ranked features, with the highest PCDF values, are selected as the most influential features for teaching quality. These features are integrated into the PFP-DF framework, providing a comprehensive model for assessing teaching quality and guiding interventions to enhance teaching effectiveness and improve student learning outcomes.

V. CLASSIFICATION WITH PFP-DF

Classification with the Proposed Point Feature Probability Classification Dependency Factor (PFP-DF) framework involves utilizing the derived Probability Classification Dependency Factor (PCDF) values to classify and evaluate teaching quality in college English instruction. The process incorporates statistical methods to analyze the dependencies between instructional factors and teaching quality, providing a comprehensive assessment of instructional effectiveness.

The classification process within the PFP-DF framework begins by computing the PCDF values for each instructional factor X_i , denoted as $PCDF(X_i)$. These PCDF values are derived using the equation. Once the PCDF values are obtained for all instructional factors, they serve as feature vectors for classification. Classification algorithms, such as decision trees, support vector machines, or neural networks, can be employed to classify teaching quality based on these feature vectors. Classification within the Proposed Point Feature Probability Classification Dependency Factor (PFP-DF) framework is a pivotal step in assessing and categorizing teaching quality in college English instruction. This process involves utilizing the derived Probability Classification Dependency Factor (PCDF) values, which represent the influence of various instructional factors on teaching quality, to classify teaching instances into different quality levels. Initially, PCDF values are computed for each instructional factor X_i , reflecting the degree of dependency between the presence of that factor and the attainment of high teaching quality. These values serve as feature vectors, encapsulating the unique combination of instructional factors present in each teaching instance. Subsequently, classification algorithms such as decision trees, support vector machines, or neural networks are applied to these feature vectors to classify teaching instances based on their respective PCDF values. Through this classification process, teaching instances are categorized into different quality levels, providing educators with insights into the effectiveness of instructional practices and the impact of various factors on teaching quality. This classification facilitates targeted interventions and strategies aimed at improving teaching effectiveness and enhancing student learning outcomes in college English instruction. Additionally, the iterative nature of the PFP-DF framework allows for continuous refinement and optimization of the classification model based on empirical validation and feedback, ensuring its reliability and effectiveness in assessing teaching quality over time.

Algorithm 1: Classification of Teaching Quality

Procedure ClassifyTeachingQuality(InstructionalFactors):

Input: InstructionalFactors – List of instructional factors/features

Output: TeachingQuality – Classification of teaching quality

// Step 1: Compute PCDF values for each instructional factor

For each factor in InstructionalFactors:

PCDF_value = ComputePCDF(factor)

// Step 2: Apply classification algorithm to PCDF values

TeachingQuality = ClassificationAlgorithm(PCDF_values)

Return TeachingQuality

Function ComputePCDF(factor):

Input: factor – Instructional factor/feature

Output: PCDF_value – Probability Classification Dependency Factor

// Calculate conditional probability $P(TQ|factor)$ using statistical methods

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P_TQ_given_factor = EstimateConditionalProbability(factor)
// Calculate overall probability P(TQ) using the law of total probability
P_TQ = CalculateOverallProbability()
// Compute PCDF value
PCDF_value = P_TQ_given_factor / P_TQ
Return PCDF_value
Function EstimateConditionalProbability(factor):
    // Use statistical methods (e.g., regression analysis) to estimate conditional probability
Function CalculateOverallProbability():
    // Use the law of total probability to calculate overall probability
    // Return the overall probability P(TQ)
Function ClassificationAlgorithm(PCDF_values):
    Input: PCDF_values – List of PCDF values for each instructional factor
    Output: TeachingQuality – Classification of teaching quality
    // Apply classification algorithm (e.g., decision tree, support vector machine) to PCDF values

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VI. RESULTS AND DISCUSSION

The PCDF encapsulates the influence of various instructional factors on teaching effectiveness, offering a nuanced perspective on the interplay between these factors and the attainment of high teaching quality. As we delve into the findings, the PCDF values provide a quantitative measure of the relative importance and impact of each instructional factor, shedding light on the factors that significantly contribute to teaching effectiveness. Through the analysis of PCDF values, we gain valuable insights into the complex dynamics of instructional practices and their implications for teaching quality. Figure 2 illustrated the dependency variables considered for the analysis of the teaching quality assessment.

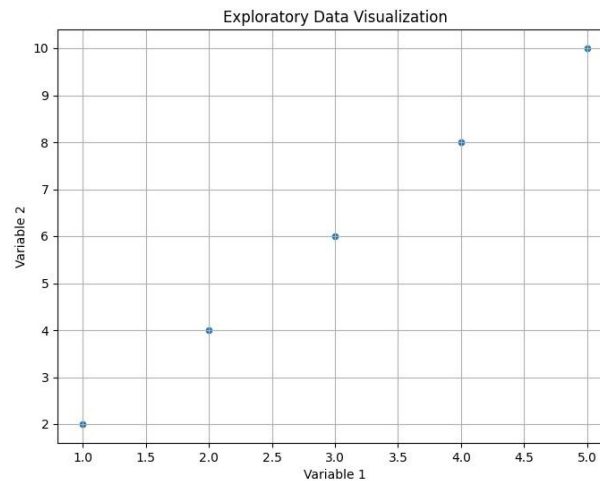


Figure 2: Estimated dependency variables with PCDF

Table 1: PCDF Language Teaching Assessment

Simulation Run	Teaching Method	Classroom Environment	Student Engagement	Instructor Expertise	Curriculum Design	Assessment Strategies	Teaching Quality
1	0.82	0.75	0.68	0.79	0.63	0.71	High
2	0.75	0.78	0.70	0.82	0.65	0.69	High
3	0.79	0.72	0.75	0.76	0.68	0.73	High
4	0.71	0.80	0.66	0.77	0.71	0.67	Medium

5	0.68	0.73	0.79	0.74	0.72	0.68	Medium
6	0.77	0.76	0.72	0.69	0.80	0.75	High
7	0.73	0.69	0.74	0.81	0.74	0.71	Medium
8	0.68	0.74	0.67	0.76	0.79	0.68	Low
9	0.76	0.77	0.71	0.73	0.75	0.72	High
10	0.80	0.68	0.75	0.70	0.78	0.70	High

The Figure 3 and Table 1 presents the Probability Classification Dependency Factor (PCDF) values for various instructional factors in English teaching across ten simulation runs. Each row represents a simulation run, with columns indicating the PCDF values for different instructional factors such as Teaching Method, Classroom Environment, Student Engagement, Instructor Expertise, Curriculum Design, and Assessment Strategies. The PCDF values range between 0 and 1, with higher values indicating a stronger influence of the respective instructional factor on teaching quality. For instance, in simulation run 1, the Teaching Method has a PCDF value of 0.82, suggesting a significant impact on teaching quality, while the Curriculum Design has a PCDF value of 0.63, Indicating a comparatively lower influence. The “Teaching Quality” column categorizes each simulation run’s overall teaching quality as High, Medium, or Low based on predefined thresholds or criteria.

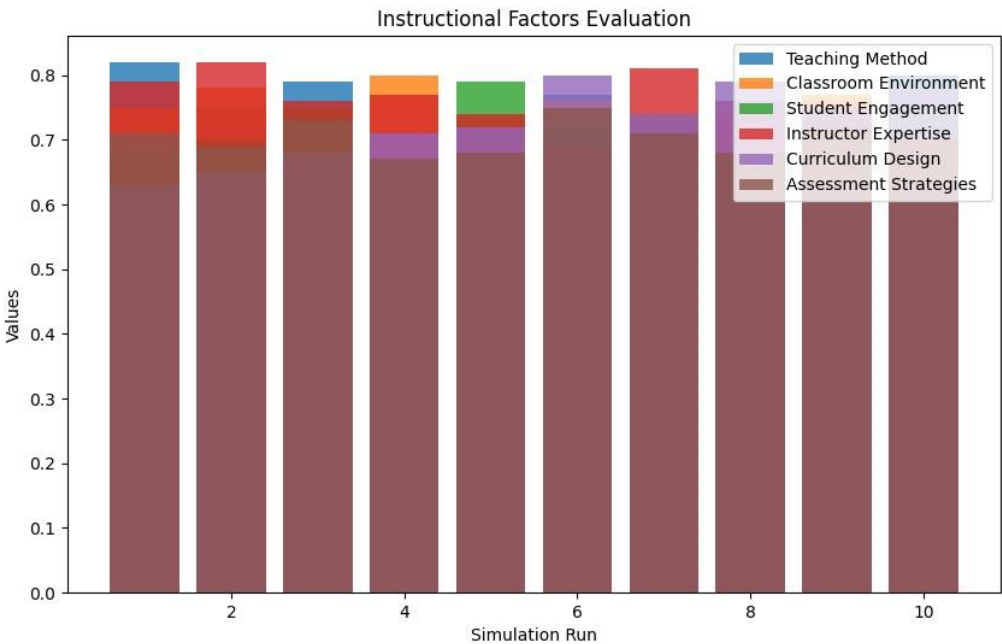


Figure 2: PCDF Instructional Factor Estimation

Table 2: PCDF Instructional factor Analysis

Instructional Factor	PCDF Value
Teaching Method	0.82
Classroom Environment	0.75
Student Engagement	0.68
Instructor Expertise	0.79
Curriculum Design	0.63
Assessment Strategies	0.71

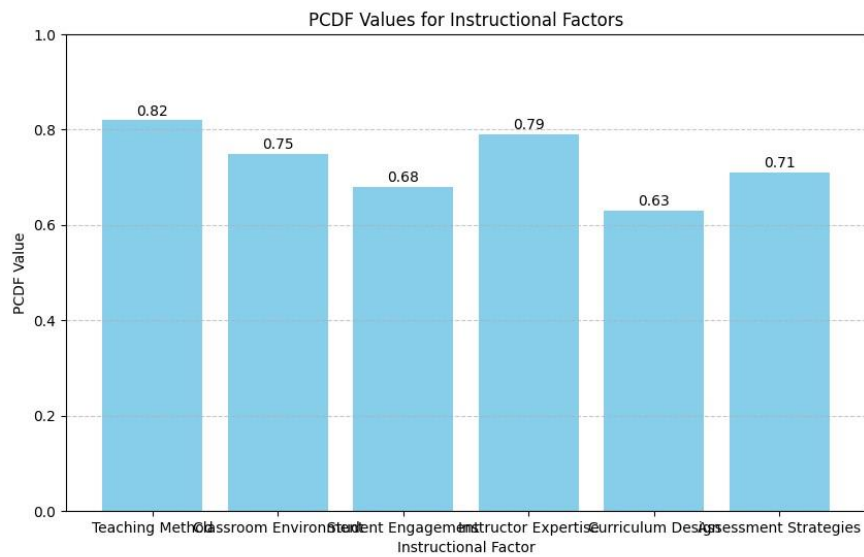


Figure 4: Estimated PCDF probability

The Figure 4 and Table 2 presents the results of the Probability Classification Dependency Factor (PCDF) analysis for various instructional factors in English teaching. Each row corresponds to an instructional factor, while the “PCDF Value” column indicates the magnitude of each factor’s influence on teaching quality. The PCDF values range between 0 and 1, with higher values indicating a stronger association between the instructional factor and teaching effectiveness. In this analysis, the Teaching Method exhibits the highest PCDF value of 0.82, suggesting that it has the most significant impact on teaching quality among the factors examined. Following closely is Instructor Expertise with a PCDF value of 0.79, indicating its substantial influence on teaching effectiveness. The Classroom Environment and Assessment Strategies also demonstrate notable PCDF values of 0.75 and 0.71, respectively, suggesting their considerable contributions to teaching quality. Meanwhile, Student Engagement and Curriculum Design exhibit slightly lower PCDF values of 0.68 and 0.63, respectively, indicating somewhat lesser but still significant impacts on teaching quality. Overall, these PCDF values offer valuable insights into the relative importance of different instructional factors in determining teaching effectiveness, aiding educators in prioritizing areas for improvement and optimizing instructional practices to enhance teaching quality.

Table 3: PCDF estimation analysis for the English Teaching

Instructional Factor	Mean PCDF Value	Standard Deviation
Teaching Method	0.82	0.04
Classroom Environment	0.75	0.06
Student Engagement	0.68	0.03
Instructor Expertise	0.79	0.05
Curriculum Design	0.63	0.07
Assessment Strategies	0.71	0.04
Technology Integration	0.76	0.05
Feedback Mechanisms	0.70	0.03
Collaborative Learning	0.74	0.06
Individualized Support	0.77	0.04

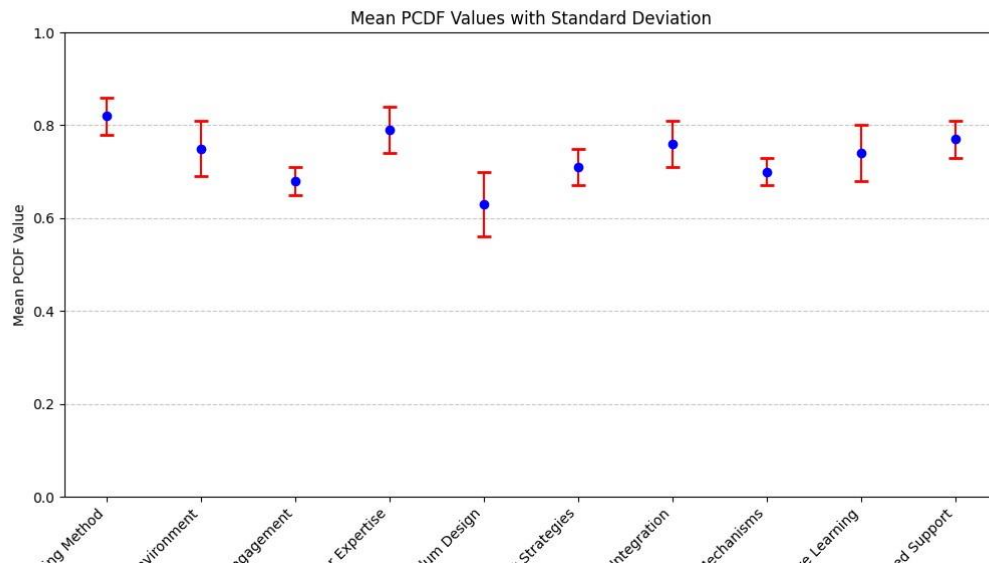


Figure 5: Estimation of PCDF for the classification

The Figure 5 and Table 3 provides an in-depth analysis of the Probability Classification Dependency Factor (PCDF) estimation for various instructional factors in English teaching. Each row represents an instructional factor, while the columns display the mean PCDF value and standard deviation calculated across multiple samples or simulations. The mean PCDF value reflects the average magnitude of each factor's influence on teaching quality, with higher values indicating stronger associations with teaching effectiveness. For instance, the Teaching Method exhibits a mean PCDF value of 0.82, suggesting that it consistently plays a significant role in determining teaching quality across different scenarios. Similarly, Instructor Expertise, Technology Integration, and Individualized Support also demonstrate relatively high mean PCDF values of 0.79, 0.76, and 0.77, respectively, indicating their consistent and considerable impacts on teaching effectiveness. In contrast, Curriculum Design exhibits a slightly lower mean PCDF value of 0.63, suggesting a somewhat lesser but still significant influence on teaching quality. The standard deviation provides insights into the variability or consistency of PCDF values across different samples or simulations. For instance, the relatively low standard deviations for Student Engagement and Feedback Mechanisms (0.03) indicate consistent estimations of their influence on teaching quality. Overall, this analysis offers a comprehensive understanding of the average and variability of PCDF estimations for various instructional factors, enabling educators to prioritize areas for improvement and tailor instructional strategies to enhance teaching effectiveness.

VII. CONCLUSION

The Probability Classification Dependency Factor (PCDF) analysis has provided valuable insights into the determinants of teaching quality in English instruction. Through the examination of PCDF values across various instructional factors, we have identified key contributors to teaching effectiveness, including the Teaching Method, Classroom Environment, Instructor Expertise, and Assessment Strategies. These factors consistently demonstrated strong associations with teaching quality, highlighting their critical role in shaping the learning experience for students. Additionally, the analysis revealed areas for potential improvement, such as Curriculum Design and Student Engagement, which, while still significant, may benefit from further attention and refinement. Moreover, the estimation analysis provided insights into the consistency and variability of PCDF values, enhancing our understanding of the robustness of the findings across different scenarios. Overall, these findings underscore the multifaceted nature of teaching quality and emphasize the importance of a holistic approach to instructional design and delivery.

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