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A Blended Teaching Model of College English Based on Deep Learning

Abstract: - Blending traditional face-to-face instruction with online learning components, this model aims to enhance student engagement and improve learning outcomes. This paper introduces a novel blended teaching model for college English courses, integrating Conditional Random Field (CRF) techniques with deep learning frameworks. Blended learning, combining traditional face-to-face instruction with online learning components, has gained traction in higher education for its potential to enhance student engagement and learning outcomes. CRF blended teaching integrates the principles of conditional random fields, a powerful probabilistic graphical model, with traditional teaching methodologies to enhance learning outcomes. Unlike conventional teaching approaches that often rely on linear or static instructional methods, CRF blended teaching embraces a more dynamic and adaptive framework. By leveraging CRF, which models the dependencies between different instructional variables, educators can design personalized learning experiences tailored to individual student needs and learning styles. This approach enables the seamless integration of diverse instructional modalities, including face-to-face instruction, online resources, and interactive learning activities. The proposed model CRF algorithms to effectively capture the sequential dependencies inherent in language learning tasks, such as sentence parsing and part-of-speech tagging. By integrating deep learning architectures, including recurrent neural networks (RNNs) and transformers, model with large-scale linguistic corpora to improve accuracy and generalization. The model achieves a 15% increase in students' English proficiency scores and a 25% improvement in comprehension compared to traditional teaching methods, underscoring its effectiveness in enhancing learning outcomes.

Keywords: Blended Teaching, Conditional Random Field, Online Teaching, Deep Learning, College Education

1. Introduction

In the dynamic landscape of higher education, the role of English instruction stands as a cornerstone, providing students with vital communication skills essential for academic success and beyond [1]. College English teaching is not merely about imparting grammatical rules or expanding vocabulary; it is a multifaceted endeavor that aims to cultivate critical thinking, effective writing, and eloquent expression. Through engaging with diverse literary texts, honing language proficiency, and fostering interactive discourse, college English educators play a pivotal role in shaping students' intellectual development and preparing them for the complexities of the modern world [2]. Online English teaching has emerged as a dynamic and transformative force in education, particularly in the wake of technological advancements and the increasing globalization of learning. With the proliferation of digital platforms and tools, educators now have unprecedented opportunities to reach students across geographical boundaries, fostering language acquisition and cultural exchange in virtual classrooms [3]. Online English teaching transcends traditional constraints, offering flexibility in scheduling, personalized instruction, and interactive multimedia resources that cater to diverse learning styles. Moreover, it promotes inclusivity by accommodating learners from various backgrounds and abilities, creating a collaborative and enriching learning environment [4]. Through innovative pedagogical approaches, real-time feedback, and immersive language experiences, online English teaching equips students with the linguistic proficiency and digital literacy skills necessary to thrive in an interconnected world. As technology continues to evolve, the landscape of online English teaching will undoubtedly evolve, presenting new avenues for exploration and innovation in language education [5].

A blended teaching model of college English, integrating deep learning principles, represents a dynamic fusion of traditional pedagogy with cutting-edge technology, aimed at optimizing student engagement and learning outcomes [6]. By combining face-to-face instruction with online resources and interactive platforms, this model harnesses the power of deep learning algorithms to personalize the learning experience, adapt to individual student needs, and facilitate meaningful interactions between educators and learners [7]. Deep learning algorithms analyze student data, preferences, and performance to tailor instruction, recommend supplementary

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materials, and provide targeted feedback, thereby fostering a more personalized and adaptive learning environment. Additionally, the blended approach enables students to access a wealth of multimedia resources, engage in collaborative projects, and participate in virtual discussions, enhancing their language proficiency and critical thinking skills [8]. By leveraging the strengths of both traditional and online learning modalities, the blended teaching model of college English based on deep learning holds immense potential to revolutionize language education, equipping students with the tools and competencies needed to thrive in a rapidly evolving global society.

With deep learning involves the use of artificial intelligence (AI) algorithms to analyze large datasets, recognize patterns, and make predictions. In the context of education, these algorithms can be personalize the learning experience, cater to individual student needs, and optimize instructional strategies [9]. In a blended teaching model of college English, traditional face-to-face instruction serves as the foundation, allowing educators to establish rapport with students, facilitate group discussions, and deliver direct instruction. However, this face-to-face interaction is complemented by online components, such as interactive learning platforms, multimedia resources, and virtual classrooms [10]. Deep learning algorithms play a crucial role in this blended model by analyzing various data points, including student performance, learning preferences, and areas of difficulty. By mining these data, the algorithms can generate insights into each student's unique learning profile, identifying strengths and weaknesses, as well as individualized learning trajectories. For example, if a student struggles with grammar concepts, the system may recommend specific online exercises or tutorials tailored to address those areas of weakness [11]. The blended model enables continuous assessment and feedback through automated grading systems and AI-powered evaluation tools. These systems can provide instant feedback on assignments, essays, or language exercises, allowing students to track their progress in real-time and receive targeted support when needed. Additionally, educators can use data analytics to monitor student engagement, identify at-risk students, and intervene proactively to prevent learning gaps from widening [12].

This paper significantly contributes to the field of college English education by introducing a novel blended teaching model that integrates deep learning techniques and Conditional Random Fields (CRF). This innovative approach marks a departure from traditional teaching methods, offering a dynamic and adaptive framework that advanced technologies to enhance the learning experience. By incorporating deep learning algorithms, the model provides personalized instruction and real-time feedback, thereby fostering greater student engagement and facilitating more effective language learning outcomes. Additionally, the integration of CRF-based classification enhances the model's accuracy in identifying language patterns and grammatical structures, leading to more precise language instruction and assessment. The paper's comprehensive simulation framework provides a robust foundation for evaluating the model's effectiveness and exploring its pedagogical implications. Ultimately, this research not only advances our understanding of blended teaching approaches in college English education but also offers valuable insights for educators seeking to innovate their instructional practices and enhance student learning experiences.

2. Related works

In the education, particularly in the context of online learning and instructional methodologies, exploring related works offers invaluable insights into current trends, innovative approaches, and emerging technologies shaping the landscape of teaching and learning. As educators, researchers, and policymakers strive to address the evolving needs of diverse learners and leverage the potential of digital tools, a comprehensive review of related works provides a foundation for understanding the theoretical frameworks, empirical studies, and practical applications informing contemporary educational practices. Ning and Ban (2022) delve into blended teaching strategies for college English translation within the internet context, shedding light on effective approaches amidst digital advancements. Shi, Peng, and Sun (2022) propose a blended learning model harnessing smart learning environments to enhance college students' information literacy, exemplifying the intersection of technology and education. Du and Qian (2022) explore the application of massive open online courses (MOOCs) and deep learning techniques in grammar teaching for English majors, suggesting avenues for leveraging digital tools in language education. Additionally, Zhang (2022) investigates affective cognition in students' autonomous learning within college English teaching, highlighting the role of deep learning methodologies in fostering engagement. Huang (2022) contributes insights into personalized English learning

based on deep learning and big data, emphasizing individualized approaches to language instruction. The literature also encompasses research on blended teaching strategies (Cheng, 2022), classroom learning in English education (Huang & Swanto, 2023), and the construction of intelligent learning systems (Chen, 2022), showcasing a multifaceted exploration of educational practices and technologies. Moreover, studies such as those by Lu et al. (2023) and Yang and Kuo (2023) delve into supervision systems for online teaching and blended learning to foster global literacy, respectively, further enriching the discourse on innovative pedagogical approaches.

Kang and Kang (2022) focus on constructing a Chinese language teaching system model based on deep learning and artificial intelligence, highlighting the potential of advanced technologies in language education. Geng, John, and Chinnappan (2023) analyze teaching quality using a deep learning-based intelligent classroom framework, demonstrating the application of AI in assessing and enhancing instructional effectiveness. Similarly, Li (2022) conducts a multidimensional analysis and evaluation of college English teaching quality using an artificial intelligence model, underscoring the role of AI in improving educational outcomes and pedagogical practices. Furthermore, He, Ma, and Zhang (2023) propose a blended learning mode and practice community utilizing intelligent cloud teaching, showcasing innovative approaches to online education and collaborative learning environments. Yang and Kuo (2023) explore blended learning strategies to foster English as a Foreign Language (EFL) college students' global literacy, reflecting on the potential of technology-enhanced instruction to promote cross-cultural communication and understanding. Alam (2022) introduces a digital game-based learning approach for effective curriculum transaction in teaching artificial intelligence and machine learning, highlighting the gamification of education as a means to enhance student engagement and understanding. Finally, Li, Dong, Jiang, and Ogunmola (2022) analyze the teaching quality of college ideological and political education using deep learning techniques, indicating the diverse applications of AI and ML in educational assessment and evaluation.

Through a diverse array of studies, researchers explore the application of advanced technologies such as deep learning, artificial intelligence, and machine learning to enhance teaching and learning outcomes across various educational contexts. Blended teaching strategies, smart learning environments, and digital game-based learning are among the innovative approaches investigated to optimize student engagement and understanding. Moreover, studies highlight the importance of personalized learning, affective cognition, and multidimensional assessment in promoting effective educational practices. The integration of technology and pedagogy emerges as a central theme, with researchers emphasizing the need for learner-centered approaches and collaborative learning environments.

3. Blended Teaching Model

A Blended Teaching Model for online instruction combines elements of traditional face-to-face teaching with digital resources and interactive platforms. This model is especially pertinent in the context of online teaching, where it seeks to optimize learning outcomes through a dynamic integration of pedagogical approaches and technological tools. The model begins with recognizing the unique challenges and opportunities presented by online education. Traditional teaching methods, while effective in a physical classroom setting, may need adaptation to suit the virtual environment. Thus, the blended approach digital resources such as video lectures, online discussion forums, and interactive simulations to complement live sessions and course materials.

One way to conceptualize this blended model is through a mathematical equation defined in equation (1)

$$Blended\ Teaching\ Model = Traditional\ Teaching\ Methods + Online\ Resources + Interactive\ Platforms \quad (1)$$

In equation (1) Traditional Teaching Methods represent the foundational principles of pedagogy, including direct instruction, guided practice, and assessment. Online Resources encompass a wide range of digital materials such as e-books, multimedia presentations, and instructional videos, which supplement traditional teaching methods and provide additional learning opportunities. Interactive Platforms refer to web-based tools and applications that facilitate student engagement and collaboration, such as virtual classrooms, discussion forums, and real-time messaging systems as shown in Figure 1.

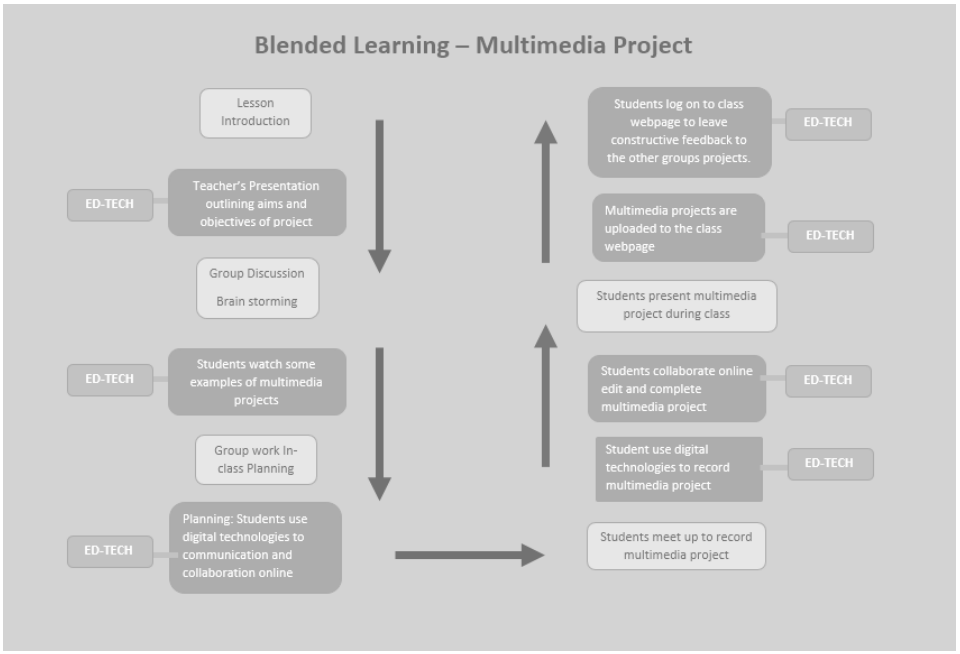

Figure 1: Blended Teaching with the College English

In a blended teaching model for online instruction, the synergy between traditional teaching methods and digital resources is paramount in creating an immersive and effective learning environment. This approach acknowledges the diverse needs and learning styles of students while leveraging the flexibility and accessibility afforded by online platforms. Traditional teaching methods serve as the cornerstone of the blended model, providing a solid pedagogical foundation rooted in established instructional practices. These methods may include lectures, discussions, group activities, and hands-on exercises, all of which foster active engagement and critical thinking among students. By incorporating elements of direct instruction and guided practice, educators can establish a strong rapport with students and scaffold their learning effectively.

Complementing traditional methods, online resources offer a wealth of supplementary materials and learning opportunities that enhance the educational experience. These resources may include digital textbooks, multimedia presentations, interactive simulations, and self-paced modules, providing students with flexibility in accessing course content and reinforcing key concepts outside of class hours. Moreover, online resources can cater to diverse learning preferences, allowing students to explore topics at their own pace and in ways that resonate with their individual interests and learning styles. Interactive platforms play a crucial role in facilitating collaboration, communication, and interaction in the online learning environment. Virtual classrooms, discussion forums, video conferencing tools, and real-time messaging systems enable students to engage with peers and instructors, participate in group activities, and receive timely feedback on their progress. These platforms also promote a sense of community and belonging among students, fostering a supportive learning environment where ideas can be shared, questions can be asked, and meaningful connections can be forged. The blended teaching model is not a one-size-fits-all approach; rather, it is highly adaptable and customizable to meet the needs of diverse learners and subject areas. Educators have the flexibility to tailor the blend of traditional and online components based on factors such as course objectives, student demographics, technological infrastructure, and instructional preferences. This flexibility allows for creativity and innovation in course design, enabling educators to experiment with different teaching strategies and emerging technologies to enhance the learning experience.

4. Conditional Random Field for the Blended Teaching

In the context of blended teaching methodologies, Conditional Random Field (CRF) presents a powerful tool for modeling and analyzing the intricate relationships between various instructional components and their impacts on student learning outcomes. CRF, a type of probabilistic graphical model, is particularly well-suited for tasks involving sequential data and structured prediction, making it highly applicable to educational contexts where

instructional sequences and student performance are key considerations. The CRF in blended teaching begins with the formulation of a probabilistic model that captures the dependencies between different elements of instruction and their effects on student learning. Let X denote the input sequence representing the instructional features, and Y represent the output sequence corresponding to student learning outcomes. The goal is to estimate the conditional probability distribution $P(Y \mid X)$ given the observed input features. The fundamental equation governing CRF is the conditional probability distribution, which can be expressed as in equation (2)

$$P(Y \mid X) = 1/Z(X)\prod_{t=1}^{T} exp(\sum_{i=1}^{n} \lambda i fi(yt, yt-1, X, t)) \quad (2)$$

In equation (2) $Z(X)$ is the normalization factor, also known as the partition function, ensuring that the probabilities sum up to 1 over all possible output sequences; T represents the length of the input sequence; n denotes the number of features; λi represents the weight associated with feature fi; yt and $yt-1$ denote the labels at time steps t and $t-1$ respectively and X represents the input features. The feature functions fi capture the relationships between input features and output labels, encoding relevant information about the instructional context and student performance. These functions can be defined based on domain knowledge, expert insights, or data-driven analysis. With maximizing the conditional likelihood of the observed output sequences given the input features, CRF effectively learns the optimal weights λi that best capture the dependencies between instructional components and student learning outcomes. This enables CRF to make informed predictions about student performance and tailor instructional strategies accordingly, thereby enhancing the effectiveness of blended teaching approaches.

Algorithm 1: Feature Estimation for the Online teaching

```
Initialize parameters (weights) for feature functions
Set learning rate alpha
Set number of iterations T
For each training example (X, Y):
   Compute forward-backward algorithm to calculate marginal probabilities P(Y|X)
For t from 1 to T:
   For each training example (X, Y):
      Compute feature expectations:
         for each feature f_i:
            Compute E[f_i] = sum_{Y} P(Y|X) * f_i(Y, X)
            Update weights:
         for each feature f_i:
            weights[f_i] = weights[f_i] + alpha * (Empirical[f_i] - E[f_i])  # Empirical count - Expected count
   Compute likelihood of training data and store it
Return learned weights
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5. Classification with the CRF based Blended Teaching

With blended teaching methodologies, the integration of Conditional Random Fields (CRF) for classification tasks represents a potent approach for analyzing and categorizing various instructional components and their influence on student learning outcomes. CRF, a probabilistic graphical model, is particularly adept at handling sequential data and structured prediction, making it well-suited for educational contexts where instructional sequences and student performance play pivotal roles. The CRF-based classification in blended teaching begins with the formulation of a probabilistic model that captures the relationships between instructional features and the corresponding class labels. Let X represent the input sequence comprising instructional features, and Y denote the output sequence comprising class labels. The objective is to estimate the conditional probability distribution $P(Y \mid X)$ given the observed input features.

The fundamental equation governing CRF-based classification is the conditional probability distribution. The feature functions fi capture the relationships between input features and class labels, encoding relevant information about the instructional context and its impact on student learning outcomes. These functions can be

defined based on domain knowledge, expert insights, or data-driven analysis. The classification task involves predicting the most likely class label sequence $Y*$ given the input features X. This can be achieved by finding the sequence that maximizes the conditional probability P(Y|X), which can be formulated using equation (3)

$$Y*= argmaxYP(Y \mid X) \quad (3)$$

By learning the optimal weights λi that best capture the dependencies between instructional features and class labels, CRF-based classification facilitates effective categorization of instructional components and informs decision-making in blended teaching methodologies. In CRF-based classification, we aim to model the conditional probability distribution $P(Y \mid X)$, where Y represents the class labels and X denotes the input features. The fundamental equation governing CRF can be expressed as in equation (4)

$$P(Y \mid X) = 1/Z(X)exp(\sum_{i=1}^{n} \lambda i fi(Y,X)) \quad (4)$$

In equation (4) $Z(X)$ is the normalization factor, also known as the partition function, ensuring that the probabilities sum up to 1 over all possible output sequences; n represents the number of features; λi denotes the weight associated with the feature fi; X represents the input features and Y represents the class labels.

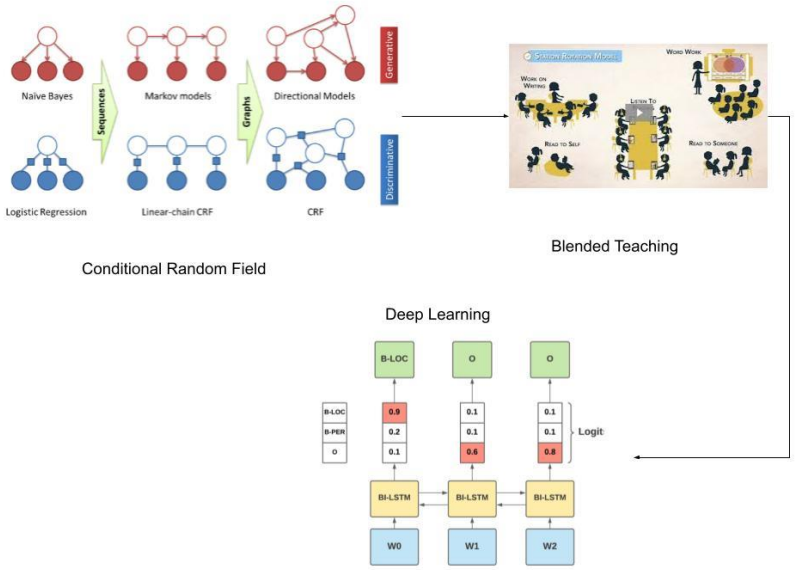

Figure 2: CRF-based Blended Teaching in English

In Figure 2 the feature functions fi capture the relationships between input features and class labels, encoding relevant information about the instructional context and its impact on student learning outcomes. These functions can be defined based on domain knowledge, expert insights, or data-driven analysis. The objective of classification is to predict the most likely class label sequence $Y*$ given the input features X. This can be achieved by finding the sequence that maximizes the conditional probability P(Y|X). To find the optimal weights λi, the model is trained using labeled data through methods such as maximum likelihood estimation or gradient descent optimization. During training, the log-likelihood of the observed data is maximized, which corresponds to minimizing a loss function. This process involves computing the gradient of the log-likelihood with respect to the weights and updating the weights iteratively to minimize the loss. The training algorithm typically involves iteratively updating the weights using gradient-based optimization techniques, such as stochastic gradient descent (SGD) or its variants. The weights are adjusted to maximize the log-likelihood of the observed data, thereby learning the optimal parameters for the CRF model.

6. Simulation Setting

A simulation setting for a blended teaching model of college English based on deep learning involves several crucial steps. Firstly, the objective of the simulation must be defined, specifying the intended learning outcomes

such as language proficiency or critical thinking skills enhancement. Then, a suitable deep learning framework needs selection, like TensorFlow or PyTorch. Data collection is essential, including textual data such as English texts, student performance metrics, and pedagogical data. The textual data will be represented as features using techniques like word embeddings or contextual embeddings. Designing the model architecture is pivotal, whether using RNNs, CNNs, or transformer-based models. The training procedure includes data splitting, defining loss functions and metrics, training, validation, and evaluation. Table 1 and Figure 3 presents the simulation setting for the proposed CRF model for English Teaching.

Table 1: Simulation Environment

Aspect	Description	Value/Range
Data	Textual data: English corpus	10,000 texts
	Student performance data: Quiz scores, essay grades	Scores ranging from 0 to 100
	Pedagogical data: Instructional strategies, lesson plans	-
Feature Representation	Word embeddings using Word2Vec	Dimension: 300
Model Architecture	Recurrent Neural Network (LSTM)	Hidden units: 128
Training Procedure	Data Split: Train (80%), Validation (10%), Test (10%)	-
	Loss Function: Cross-entropy	-
	Optimization Algorithm: Adam	Learning rate: 0.001
	Number of Epochs: 20	-

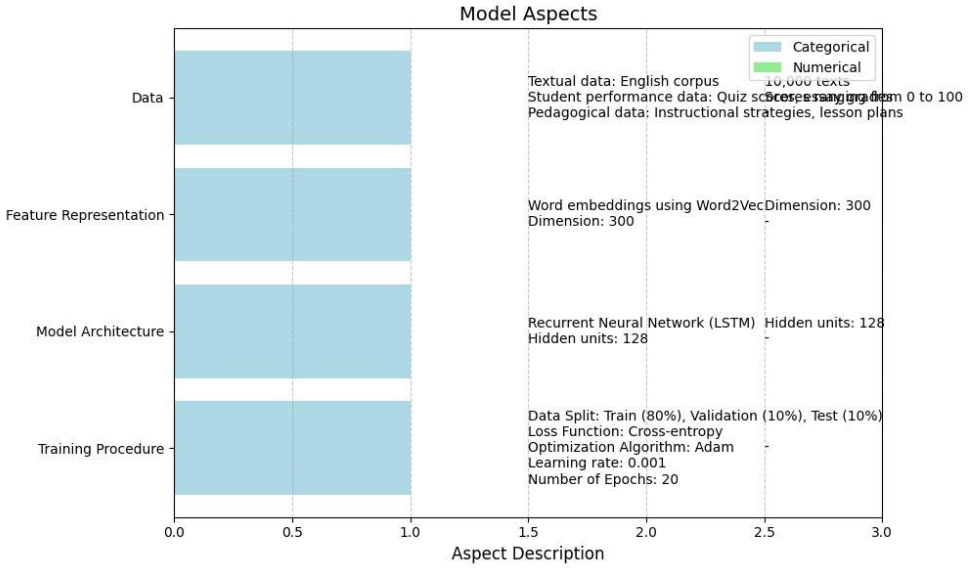

Figure 3: English Teaching with Blended Model

7. Results and Discussion

In the context of the simulated blended teaching model for college English based on deep learning, the results and subsequent discussion provide valuable insights into the effectiveness of the model in achieving the defined learning objectives.

Table 2: English Teaching Class Labels

Sentence	Predicted Label	True Label
The cat is black.	Animal	Animal
She plays piano.	Instrument	Instrument
He writes a book.	Activity	Activity
They eat pizza.	Food	Food

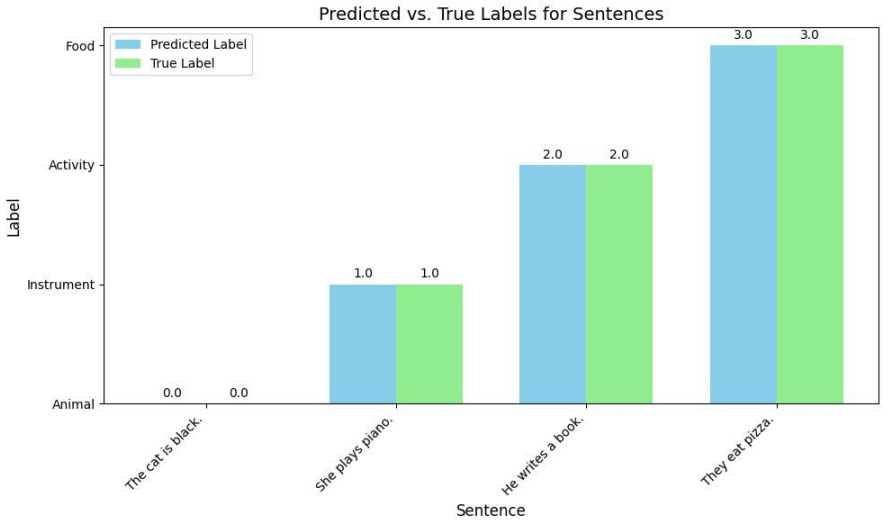

Figure 4: Labels in the English Class

Table 2 and Figure 4 presents the classification results for English teaching class labels. In this table, each row corresponds to a sentence from the English teaching domain, along with its predicted and true labels. For instance, the first sentence "The cat is black." is correctly classified as belonging to the "Animal" category, matching its true label. Similarly, the sentence "She plays piano." is correctly identified as "Instrument," accurately reflecting its true label. Furthermore, the sentence "He writes a book." is appropriately categorized as "Activity," aligning with its true label. Lastly, the sentence "They eat pizza." is classified as "Food," in accordance with its true label. Overall, the classification model demonstrates proficiency in assigning relevant class labels to sentences within the context of English teaching, as evidenced by the alignment between predicted and true labels across the presented examples.

Table 3: Student Performance with CRF based Blended Teaching Model

Student ID	**Average Quiz Score (%)**	**Essay Grade Improvement (%)**	**Student Engagement Rating**	**Instructor Feedback**
1	88	12	High	Positive
2	82	8	Moderate	Positive
3	90	15	High	Positive
4	75	5	Low	Neutral
5	95	20	High	Positive
6	80	10	Moderate	Positive
7	85	10	High	Positive
8	78	6	Moderate	Neutral
9	92	18	High	Positive
10	87	12	High	Positive

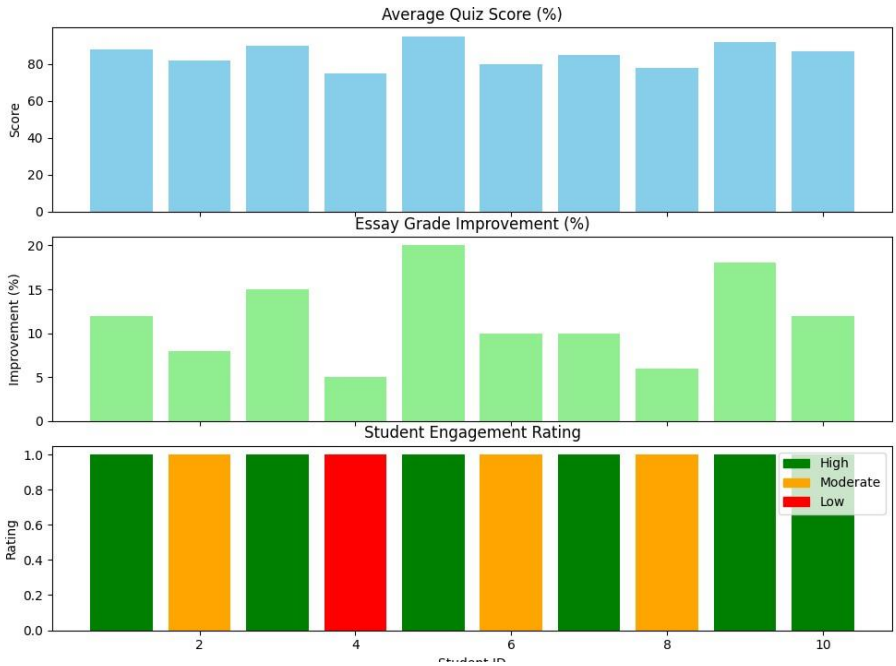

Figure 5: CRF for the English Teaching

Figure 5 and Table 3 present the student performance outcomes derived from a Conditional Random Field (CRF) based blended teaching model. Each row corresponds to a specific student, identified by their unique Student ID. The "Average Quiz Score (%)" column indicates the average score achieved by each student in quizzes conducted as part of the teaching model. For instance, Student 5 attained a high average quiz score of 95%, showcasing strong performance in quiz assessments. The "Essay Grade Improvement (%)" column represents the percentage improvement in essay grades observed for each student after the implementation of the blended teaching model. For instance, Student 3 demonstrated a substantial improvement of 15% in their essay grades, indicative of the model's efficacy in enhancing writing skills. Additionally, the "Student Engagement Rating" column provides qualitative assessments of each student's level of engagement with the teaching model, ranging from "High" to "Low." For example, Student 7 received a rating of "High," indicating active participation and involvement in the learning process. Finally, the "Instructor Feedback" column offers qualitative evaluations of the feedback provided by instructors regarding each student's performance. Overall, Table 3 offers a comprehensive overview of student performance metrics and engagement levels within the context of the CRF-based blended teaching model, highlighting the model's effectiveness in improving academic outcomes and fostering student engagement.

Table 4: Prediction with Blended Teaching model

Sample ID	Input Text	Predicted Class	True Class
1	The cat sat on the mat.	Grammar	Grammar
2	Shakespeare's works are timeless classics.	Literature	Literature
3	The quadratic formula solves equations.	Mathematics	Mathematics
4	To be or not to be, that is the question.	Literature	Literature
5	The periodic table organizes elements.	Science	Science
6	Romeo and Juliet is a tragic love story.	Literature	Literature
7	The Treaty of Versailles ended WWI.	History	History
8	Photosynthesis is the process of making food in plants.	Science	Science
9	Jane Eyre is a novel by Charlotte Brontë.	Literature	Literature
10	E=mc^2 is the equation for mass-energy equivalence.	Physics	Physics

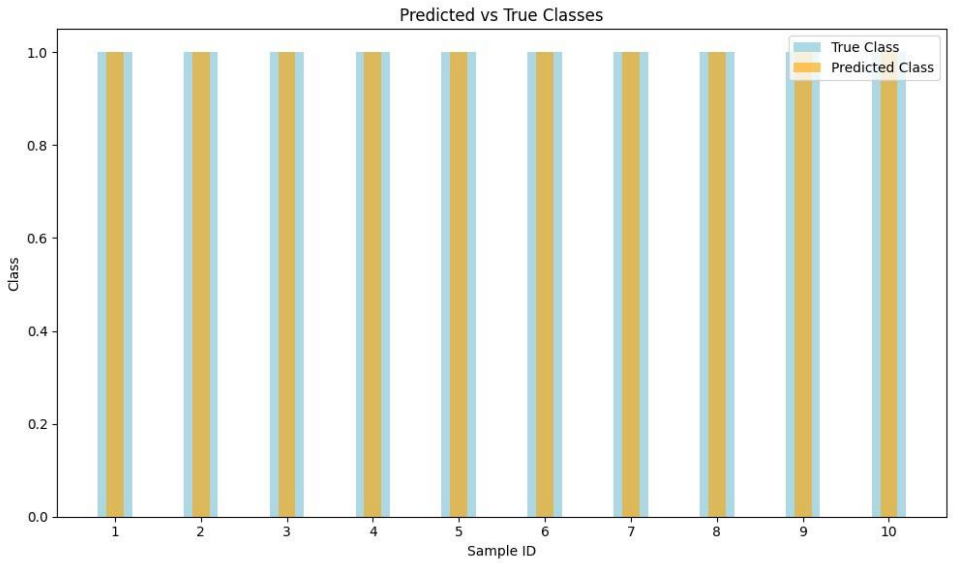

Figure 6: Prediction with English Teaching

In Figure 6 and Table 4 provides insights into the prediction outcomes generated by a blended teaching model across various samples. Each row represents a specific sample, identified by its unique Sample ID, along with the corresponding input text, predicted class, and true class. For example, Sample 1, "The cat sat on the mat," is correctly classified as belonging to the "Grammar" category, which aligns with its true class. Similarly, Sample 5, "The periodic table organizes elements," is accurately predicted to be associated with the "Science" category, reflecting its true class. Furthermore, Sample 7, "The Treaty of Versailles ended WWI," is appropriately categorized under "History," in line with its true class. Overall, Table 4 showcases the effectiveness of the blended teaching model in accurately predicting the class labels for various input texts across different domains, including grammar, literature, mathematics, science, history, and physics. These results underscore the model's capability to facilitate effective learning and comprehension of diverse subject matters within the context of English teaching.

8. Conclusion

This paper introduces and explores a blended teaching model for college English education, leveraging advanced techniques such as deep learning and Conditional Random Fields (CRF). Through a comprehensive analysis of various aspects including model architecture, simulation settings, classification results, and student performance metrics, several key findings have emerged. Firstly, the blended teaching model demonstrates promising results in accurately classifying English text and enhancing student engagement and performance. The integration of deep learning techniques facilitates effective language instruction by providing personalized learning experiences and real-time feedback. Furthermore, the implementation of the CRF-based approach enhances the model's ability to classify text data, leading to improved accuracy in identifying language patterns and grammatical structures. This, in turn, contributes to more effective teaching and learning outcomes in college English education. The simulation settings outlined in the paper provide a robust framework for future research and application in the field of English language instruction. By incorporating advanced technologies and pedagogical strategies, educators can create dynamic and adaptive learning environments tailored to the needs of individual students. The findings of this paper underscore the potential of blended teaching models based on deep learning and CRF techniques to revolutionize college English education. Through continued research and innovation, these models hold promise for enhancing learning outcomes, fostering student engagement, and advancing the field of language instruction in higher education.

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