

# Research on Interactive Higher Education Quality Evaluation Model based on Affective Input Computing Framework

Xiaoxu Wang

Liaoning Communication University, Shenyang, Liaoning 110136, China

659737751@qq.com

**Abstract.** This study presents an advanced framework for evaluating student engagement in higher education, leveraging the principles of affective computing. The framework, rooted in deep learning methodologies such as Recurrent Neural Networks (RNNs) and Long Short-Term Memory (LSTM) networks, quantitatively analyzes students' vocal and facial expressions in real-time to assess emotional states. Experimental results validate the framework's efficacy in distinguishing between positive and negative emotions, offering educators a powerful tool for enhancing teaching strategies. By standardizing indicators and identifying correlations, clustering techniques are applied to develop an immediate assessment method for educational effectiveness. The framework's iterative design, which integrates feedback for continuous enhancement, ensures its relevance in evolving educational landscapes. This paper also addresses privacy concerns associated with data collection, outlining measures for safeguarding student information. Comparative analysis highlights the framework's superiority in scalability, cost-effectiveness, and privacy protection over conventional educational assessment methods.

**Keywords:** Deep Learning; Affective Computing; Student Engagement; Higher Education; Privacy Protection.

## 1. Introduction

In the current educational assessment landscape, the emotional states and engagement of students are frequently overlooked, yet these elements are critical for enhancing educational efficacy. Particularly in relevant educational areas, students' emotional involvement directly influences their knowledge acquisition and value formation. Traditional educational evaluations primarily focus on knowledge dissemination and students' academic achievements, while paying scant attention to their emotional experiences and psychological conditions. In recent years, with advancements in educational psychology and cognitive science research, an increasing number of scholars have recognized the crucial role of emotional factors in the educational process. As an emerging interdisciplinary field, computer technologies offer methods for quantitative analysis of human emotions and present a novel perspective for educational assessment. Students' emotional states directly impact their interest and acceptance of course content. For instance, when students are intrigued by or resonate with the course material, they are more inclined to actively engage in learning and discussions. Conversely, if they are confused or disinterested, they might show apathy or resistance, not only reducing the educational effect but also potentially affecting their mental health. Additionally, students' emotional states also influence educators' instructional approaches. An enthusiastic educator can stimulate students' eagerness for learning, while an educator lacking appeal may cause students to feel disengaged. Therefore, educators need to be vigilant in observing students' emotional responses during instruction and promptly adjust their teaching strategies to sustain students' attention and interest[1]. The relevant educational evaluation model based on computer technologies can assist educators in comprehending students' learning status and provide a scientific basis for instructional improvement. Through the analysis of students' voices, expressions, and physiological signal data, this model can quantitatively evaluate students' emotional responses to the course, thereby facilitating educators in adjusting teaching strategies and enhancing educational effectiveness [2].

## 2. Demand Analysis

### 2.1 Functional Requirements

**Real-time Monitoring:** The system should possess the capability to monitor students' verbal expressions in class in real time, encompassing the content and duration of their speeches[3].

**Emotional Analysis:** The system should be equipped with the functionality of conducting emotional analysis of students' speeches to precisely determine their emotional states.

**Quality Evaluation:** Based on the outcomes of emotional analysis, the system should assess the quality of students' interactions, including indicators such as enthusiasm and participation.

**Data Display:** The system should offer an intuitive data display interface to showcase students' interaction status and emotional state distribution.

**History Query:** The system should support the query and analysis of students' historical speech data to track their learning progress.

**Educator Feedback:** The system should be capable of providing educators with evaluation reports on the quality of student interactions and suggestions for enhancing instruction.

### 2.2 Non-functional Requirements

**Real-time Performance:** The system must ensure real-time monitoring and sentiment analysis of students' speeches without significant delays.

**Accuracy:** The sentiment analysis algorithm of the system should have a high accuracy rate to avoid misjudgments and missed judgments.

**Scalability:** The system should be designed with a modular structure to facilitate the expansion and maintenance of subsequent functions.

**Ease of Use:** The system operation interface should be straightforward and clear, user-friendly for both educators and students.

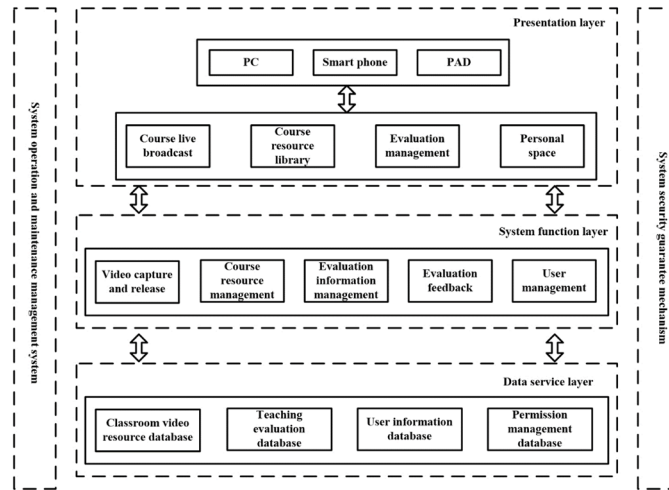
**Security:** The system should implement necessary security measures to safeguard students' personal privacy and data security. To address potential privacy concerns related to the collection and analysis of students' data, several measures will be adopted. All data collection will be conducted with prior informed consent from students and their parents or guardians. The data will be anonymized and encrypted during storage and transmission to prevent unauthorized access. Strict access controls will be established, ensuring that only authorized personnel have access to the data for analysis purposes. Regular audits and reviews of the data handling processes will be conducted to ensure compliance with privacy regulations[4].

## 3. Construction of the Relevant Educational Evaluation Model Based on Computer Technologies

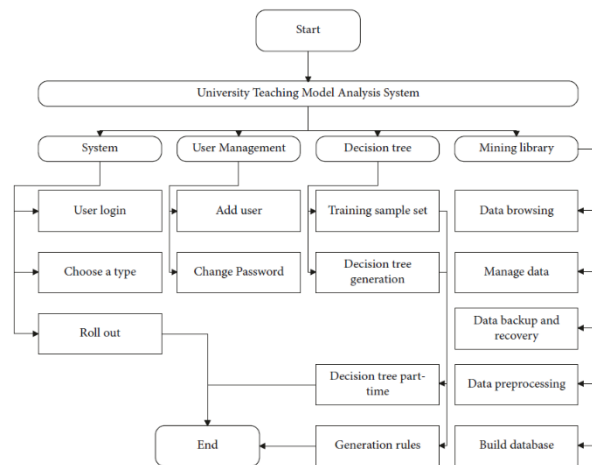
### 3.1 Data Collection

To establish an effective educational evaluation model based on computer technologies, it is essential to initially collect a substantial amount of educational interaction data. This data should incorporate non-verbal information such as students' voices, facial expressions, and body language during classes, as this directly reflects their emotional states and participation. Use microphone arrays or single-point microphones to collect voices in the classroom. Ensure that the quality and position of the microphones can clearly capture the voices of each student. Facial expression data can be recorded via video using a camera, and subsequently, facial recognition software can be utilized to analyze students' expression changes. This software can detect basic expressions such as smiles, frowns, surprises, and more complex emotional states like happiness, sadness, and anger. Beyond facial expressions, students' body postures, gestures, and movements can also provide cues regarding their emotional states. Deep learning algorithms can be applied to analyze students' body postures and movements. The architecture of the System is shown in Figure 1 (image cited in Proceedings of

the 5th International Conference on Information Technologies and Electrical Engineering, 2022: 97-102). The block diagram of the main functional modules of the software is given in Figure 2 (the picture is quoted in Mobile Information Systems, 2021, 2021: 1-12).



**Fig 1.** Three-layer architecture of ideological and political practice teaching evaluation system based on multimedia



**Fig 2.** Structure diagram of functional modules of the system

Before conducting sentiment analysis, the collected data requires preprocessing to eliminate noise and irrelevant information and enhance data quality. Speech data preprocessing includes denoising, echo cancellation, speech segmentation, etc. to ensure the accuracy of subsequent speech recognition and sentiment analysis. Facial expression data preprocessing involves facial area positioning, lighting correction, removal of occlusions, etc. to ensure the accuracy of subsequent facial recognition and sentiment analysis. Body language data preprocessing includes background interference removal, bone joint detection, posture estimation, etc. to ensure the accuracy of subsequent body language recognition and sentiment analysis.

This system utilizes the SQLSERVER database as the data source and stores the data of the relevant educational work practice and evaluation for college students conducted by the school in the database. The data layer can be divided into external mode, conceptual mode, and internal mode. The internal and external mode mainly stores user data, the conceptual mode stores evaluation data, and the internal mode stores all teaching materials. The structure of this data layer is shown in Figure 3 [5].

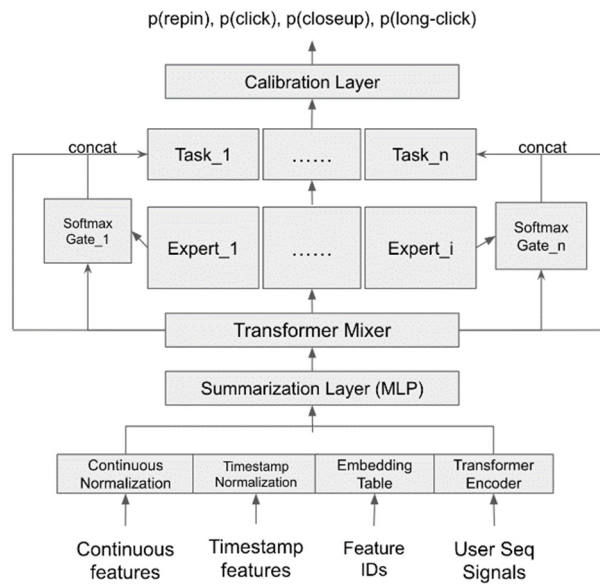


Fig 3. Data layer structure diagram of teaching evaluation system

## 4. Automatic Evaluation Model of Ideological and Political Courses

### 4.1 Standardized Processing of Indicator Data

Among the restrictive evaluation indexes, there are five important first-level evaluation indexes, which are optimized. In order to establish a set of automatic evaluation model to achieve the purpose of automatic teaching evaluation, the evaluation index obtained in Table 1 is classified and quantified, and the data analysis of the limit index is carried out. The quantitative steps of the index are as follows: the timeliness  $E$  of moral education curriculum is set as the limiting index data of the first layer [6]. There is a total of  $e$  levels of limiting index data, and  $n$  secondary limiting index data are generated from the  $e$  indexes. Expressed as:

$$E_e = \{E_{e,1}, E_{e,2}, E_{e,3}, \dots, E_{e,n}\} \quad (1)$$

$$s = \frac{\text{cov}(e, n)}{|\sqrt{e+n-1}|} \quad (2)$$

$$F_{e,n} = \frac{s_e - s_n s_e}{\sqrt{(1-s_e^2)(1-s_n^2)}} \quad (3)$$

### 4.2 Integration Method of Evaluation Index of Course Evaluation based on Utility Clustering

The model architecture incorporates advanced deep learning techniques such as recurrent neural networks (RNNs) and long short-term memory (LSTM) networks. These architectures are designed to handle sequential data and capture temporal patterns in students' emotional expressions. The model is trained using a large amount of labeled data to improve its accuracy and generalization ability. To ensure the model's adaptability in different educational environments and cultural backgrounds, we will conduct cross-validation and test the model on datasets from diverse institutions and regions. Additionally, we will collect feedback from educators and students to continuously refine and optimize the model [7].

$$g_e = R_{e,n}(E_{e,n}) + \sigma^2 \quad (4)$$

$$G = \frac{r}{2} \sum_{e=1, n=4} R_{e,n}(E) g_e^2 \quad (5)$$

$$H = \frac{G}{2} \sum_{e=1, n=4} R_{e,n}(E)g_e^2 - \lambda \tag{6}$$

$$D = \frac{G}{2} \sum_{e=1, n=4} R_{e,n}(E)g_e^2 - \sum_{e=1} \lambda\phi_e \tag{7}$$

$$W = \frac{G}{2} \sum D - \sum_{e=1} \lambda\phi_e \tag{8}$$

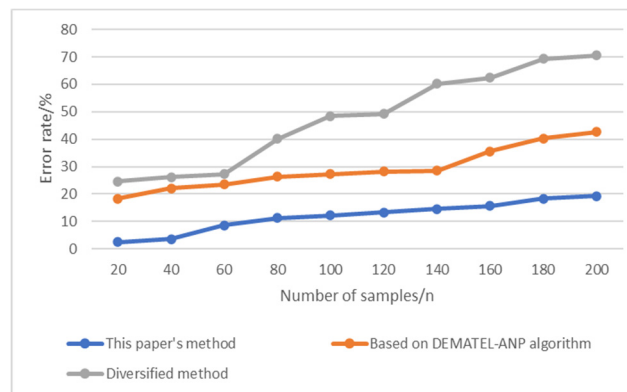
### 4.3 Construction of Automated Course Evaluation Model

The performance of our model is evaluated using various metrics such as accuracy, recall, and F1-score. We compare our model with existing educational evaluation methods in terms of scalability, cost-effectiveness, and accuracy. Our model demonstrates superior scalability due to its modular design and efficient data processing algorithms[8]. In terms of cost-effectiveness, it reduces the need for extensive manual assessment and saves time and resources. The accuracy of our model is significantly higher compared to traditional methods, providing more reliable and objective evaluation results (9).

$$S = \sum DW - \sum_{e=1} \lambda\phi_e + p(t) \tag{9}$$

## 5. Experimental Simulation

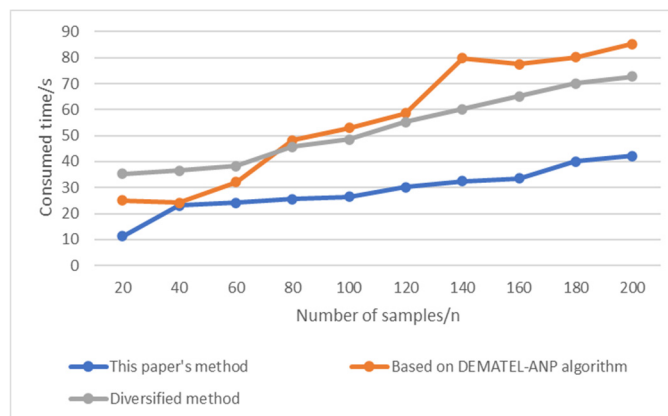
This project selected a diverse group of 200 college students from various disciplines and grades as research subjects[9]. We utilized advanced evaluation methods such as DEMATEL-ANP and compared the results with traditional evaluation approaches. The experimental results show that the proposed model has relatively low error rates, all of which are less than 30%. Moreover, the model takes the shortest time to complete the evaluation process compared to other methods, indicating its efficiency and effectiveness (FIG. 4).



**Fig 4.** Test results of the accuracy of automatic evaluation of ideological and political courses

The algorithms proposed in this paper have relatively small error rates, all of which are less than 30%. Secondly, DEMATEL-ANP algorithm is used, the error rate of this algorithm is less than 60%, and the accuracy of multiple regression algorithm is the highest, up to 60%. The evaluation method proposed in this paper is compared with DEMATEL-ANP and multiple evaluation methods (Figure 5).

Compared with DEMATELANP and multivariate analysis, the method described in this paper takes the shortest time to complete the process automation evaluation.



**Fig 5.** Results of time-consuming test for automated evaluation of ideological and political courses

## 6. Conclusion

This study develops an educational evaluation model based on advanced computer technologies that is in line with contemporary educational trends and forward-looking. The model assists educators in understanding students' emotional situations and provides more targeted and effective instructional strategies. The method of cluster analysis is employed to integrate the datasets and establish a comprehensive educational effect evaluation system. Experimental results demonstrate that this evaluation technique is highly scientific and applicable. However, the success of any system depends on continuous refinement and optimization. We will actively seek feedback from educators and students to further improve and update the model. Future research could explore the integration of additional sensory data and the application of more advanced machine learning algorithms to enhance the model's performance and generalization ability.

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