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Article

Application research of psychological feedback monitored by biosensors in ideological and political education intervention for college students

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Abstract: In many countries, a core component of academic instruction is ideological and political education (IPE), which aims to comprehend important political ideas, social ideals, moral reasoning, and civic responsibilities. College students' mental health is deteriorating due to increased academic demands, social expectations, and maturity adjustment, impacting their personal growth and potential societal contributions. This research explores applying psychological feedback systems, monitored by biosensors, as an intervention tool in IPE for college students. A novel refined hippopotamus-optimized adaptive deep recurrent neural network (HO-ADRNN) is proposed to evaluate the psychological feedback. To collect information on students' emotional and cognitive states during educational sessions by using biosensors, such as heart rate variability (HRV) monitors and electroencephalography (EEG) monitors. The data was preprocessed using data cleaning to remove noise from the obtained data. Short-Time Fourier Transform (STFT) was used to extract the features of biosensor data. The ADRNN and HO algorithms are designed for assessing psychological feedback, while RNNs offer strong skills for processing sequential data and identifying temporal correlations. The results demonstrate the proposed method allows educators to tailor their teaching methods and content delivery in response to students' psychological conditions, fostering a more engaging and supportive learning environment. The proposed method of HO-ADRNN has achieved 98.89% in Accuracy, 94.91% in Precision, 93.96% in Recall, and 94.05% in F1 score. The HO-ADRNN model demonstrates that technology can improve students' understanding of ideological concepts while also addressing their mental health needs.

Keywords: psychological feedback; biosensors; ideological and political education (IPE), college students; refined hippopotamus optimized adaptive deep recurrent neural network (HO-ADRNN)

1. Introduction

Ideological and Political Education (IPE) plays an important role in the civil, and social teaching of students and is oriented towards the recognition of values and political obligations. While useful in typical college settings where students are exposed to a different range of ideas have contend with a variety of challenges, IPE is also protective in the carriage of those experiences [1]. However, employing some conventional techniques of argumentation, such as lectures and talks, poses challenges in addressing students, especially when emotional autonomy and cognitive factors like anxiety and stress get in the way of processing information. This emphasizes the importance of individual differences in the implementation of IPE activities and the awareness of the psychological state of students at that time. Many biosensors are capable of monitoring brain activity, measuring heart rate variability (HRV), and electrodermal activity (EDA) among other features [2,3]. These biosensors track a student's emotional and physical condition during class, providing the teacher with essential feedback on the student's stress levels, focus, and motivation. The teacher can be aware of the students' responses concerning certain teaching methods, which in turn informs the modification of the instruction or improvement of the classroom conditions to facilitate the active involvement of the students [4]. Those students who are undergoing emotional pain can find it hard to concentrate or participate optimally, while those who are emotionally balanced can assimilate information easily and participate actively [5]. Therefore, the application of biosensors facilitates IPE interventions by offering real-time psychological feedback that responds to the emotional needs of the students [6]. One of the challenges that characterize the traditional IPE model is the difficulty educators face in accessing and understanding students' emotional responses, which can impede the timely revision of teaching techniques. The approach, when necessary, intervenes by engaging lead the psychological systems in sensor technology included in the biosensor systems, which helps mitigate this problem [7]. For instance, increased heart rate variability can signal a certain level of enhancement, whereas minimal variability may indicate disinterest. Educators can seek convergence of such physiological responses and make the necessary changes with the lectures or activities [8]. **Figure 1** shows the benefits of IPE learning in the lives of college students.

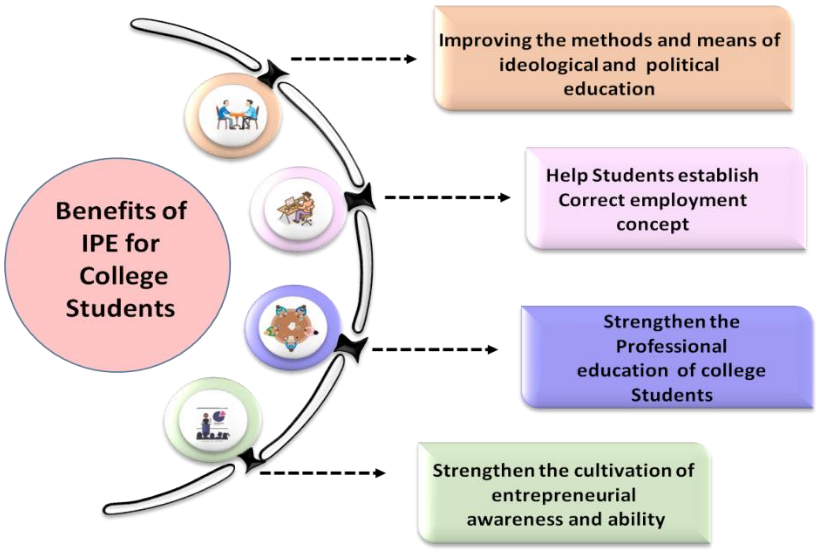

Figure 1. Benefits of IPE learning.

The implementation of psychological feedback is an impressive tool for teaching quality improvement. Teachers understand the gap between the delivery of the lesson as planned and practiced, which is in most cases elicited by students' moods. More productive interactions and learning can be achieved as well when the lesson is modified to hold the attention of the students more effectively [9–11]. Understanding the emotions of the students promotes the effectiveness of group tasks as well as the expression of different political views without the fear of being victimized. Interventions through biosensors also enable the students to control their feelings, which are a key aspect of learning [12]. The mechanism of emotional regulation is about controlling feelings in adverse situations, which is relevant in IPE issues subject to discussion and can be quite sensitive, especially where political or moral issues are at stake. Regarding emotional control, if a student has difficulty regulating their response, they may either become quiet or aggressive, which reduces the effectiveness [13]. Biosensors can allow instructors to avert emotional disturbances before they manifest themselves to students, making it possible to implement interventions that can enhance students' management of emotions and their coping strategies in interactions that involve difficult discussions [14,15]. The objective of this study is to incorporate psychological feedback through biosensors into IPE interventions to address emotional and cognitive aspects of learning, providing a more personalized educational experience.

Contribution of the study

- Integration of psychological feedback system: The investigation is to introduce active psychological feedback devices, which will be measured using biosensors, into IPE. The heart rate variability (HRV), electroencephalography (EEG) devices, etc. allow for the innovative monitoring of students' feelings and thoughts during the learning process. Such a combination makes it possible to reveal the specifics of students' success and their prerequisites' perception of a learning process.
- Development of HO-ADRNN model: The refined hippopotamus-optimized adaptive deep recurrent neural network (HO-ADRNN) is an innovation in evaluating psychological measures of feedback in education. Not only does this model improve student mental health evaluation, but it also enhances IPE programs designed for every individual. Advanced algorithms allow for the correct information processing and understanding of the most intricate psychological data, and teachers get to know their students' participation, as well as their emotional status.
- Personalized learning experiences: By proving that the HO-ADRNN model is responsible for modifying the facilitator's approach to the content based on the psychological state of the students, this paper seeks to promote the idea of customized learning. This means that emotional support is essential in the educational process to ensure that appropriate pedagogical strategies are applied without negatively affecting learners' mental health.

The rest of the paper is articulated as follows: Phrase 2 highlights the literature review, Phrase 3 brings out the methods that were used in this study, and Phrase 4 presents the performance analysis and discussion, while Phrase 5 provides the conclusion of this study.

2. Literature review

The internet has completely changed how people live and work, but it has also had a devastating impact on IPE instruction in higher education. In the network era, creative approaches to moral values promotion and positive learning attitude cultivation. It draws attention to the necessity of successful innovation in these fields [16]. Using documentation from the communist party and state sources as well as interviews with managers, instructors, student counselors, and students from three institutions, investigates the policies and procedures surrounding IPE in Chinese universities. It demonstrates how these establishments institutionalize patriotism as a suitable ideological viewpoint for pupils, providing factual proof of formal instruction, structures headed by political parties, and a range of other activities that were explored [17]. The significance of IPE in mending ideological rifts in contemporary democracies is covered in this chapter. To assist educators, politicians, and citizens alike, the chapter emphasizes the transformational power of IPE in promoting cohesiveness, tolerance, and unity in different communities [18].

The need to enhance college students' IPE was discussed in light of the fast advancement of society. It implies that mobile internet can act as a fresh venue for these classes, giving them more energy and advancing their learning. Draw attention to certain possible drawbacks of mobile internet use and suggest a fresh approach to guarantee college students receive a thorough integration of mobile internet with IPE [19]. An enhanced collaborative filtering algorithm and the analytic hierarchy process (AHP) for a recommended system of political and ideological education. Using boundary completion and prediction score rounding filling, the system anticipates missing values. The system's correctness and viability were confirmed by experimental findings, which makes it a valuable tool for advancing IPE [20]. Artificial intelligence (AI) technologies restructure IPE courses at colleges and universities. Its main goals were to solve current issues and optimize the course environment. Four systems were suggested by the study: network growth, coordinated cooperation, methodical design, and timely information for decision-making on complicated topics and to assist in overcoming timeliness challenges [21]. According to [22], a data mining and AI-based methodology for managing higher education at universities. It employs a local sensitive hash function for representative point sets and enhances conventional techniques. A control experiment shows the model's high performance and usefulness by contrasting it with conventional techniques. By addressing flaws in existing assessment methods, this research seeks to build a scientific evaluation model for the ideological education of students. It suggests using a conventional multi-layer fuzzy assessment model. To overcome limitations, the model combines fuzzy information processing, self-adaptive learning, association, recognition, and learning. An analysis was carried out with a local institution, proving the efficacy and scientific validity of the entire evaluation approach [23].

The managerial variables influencing college students' IPE in the modern period are examined in the research. It examines the state of IPE in colleges today, emphasizing both the positive and difficult elements. The level of IPE in colleges is lower than in middle schools, highlighting the need to enhance IPE in colleges. Therefore, it is concluded that college IPE must be improved [24]. Due to the effects of their social environments, college students' ideological dynamics have undergone tremendous change, with psychological reception processes deviating greatly from self-cognition. The state has placed a strong emphasis on bolstering IPE at colleges and universities, together with humanistic care and psychological counseling. To maximize psychological education's helpful function analyses and provides guidelines for creative IPE that follow these principles [25]. The architecture, operation, and workflow of vertical search engines were the main topics of the article, which investigates the retrieval of IPE materials in higher education. It creates a social network service model-based system for sharing educational resources and solving problems like subject idea set expression and significance judgments with a vector space model and topic search engine architecture. Tests were conducted on the system's functioning and performance to show off its potential [26]. Virtual reality (VR) technology is essential for teaching IPE at colleges and universities. To facilitate resource sharing, heterogeneous integration, horizontal connectivity, and dynamic maintenance, it specifies the component model and interactive topology of Internet of Things (IoT) application systems. To emphasize variations in instructional software components, design concepts, and structural qualities, analyses reference models. Methods for developing application systems can be established in the future [27].

3. Methodology

This study examines the incorporation of feedback systems that are biosensor-controlled in the IPE of college students. The increasing pressure in academics coupled with the rising issues of mental health among students has made this study enhance the learning process through the provision of emotional and cognitive data on a real-time basis. This study is grounded in the innovative use of biosensors to enhance the engagement of learners with content as well as their comprehension of the political content taught. The importance of mental health and education as two critical aspects of life emphasizes the need to address these issues simultaneously in nurturing every student. **Figure 2** represents the schematic diagram of the methodology flow.

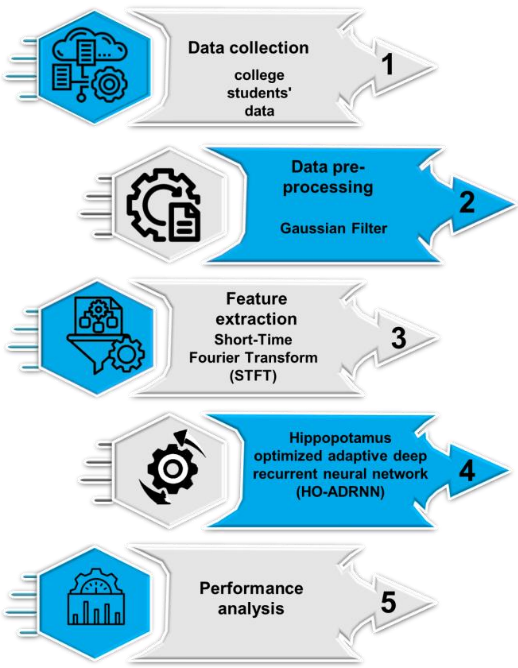

Figure 2. Schematic diagram of methodology flow.

3.1. Data collection

The 200 college students' data were collected and their emotional and cognitive states during educational sessions using biosensors, specifically heart rate variability (HRV) monitors and electroencephalography (EEG) monitors. HRV measures variations in time between heartbeats, reflecting the autonomic nervous system's activity and helping to assess stress levels and emotional well-being during IPE interventions. In contrast, EEG monitors brain electrical activity, providing insights into cognitive engagement, mental fatigue, and emotional arousal.

3.2. Data pre-processing using Gaussian filter

Gaussian filtering is incorporated in this approach to improve the image of college students' data by reducing noise before classification. Thus, it is ensured that the visual learning materials for students are crisp and clear. A linear filter with an assigned weight is used on each component of the image by the shape of the Gaussian curve. It is an ideal filter in this instance because it sharpens and maintains vital details while reducing visual noise, which is a common problem with visual teaching aids. Thus, with this approach, high-quality materials will be created for the students to improve their knowledge and interest in the subject of IPE. To determine the percentages of each of the elements in the filter, the following Equation (1) would be appropriate.

$$g(w,z) = \frac{1}{d} f^{\frac{w^2+z^2}{2\sigma^2}} \tag{1}$$

3.3. Feature extraction using Short-Time Fourier Transform (STFT)

The Short-Time Fourier Transform (STFT) is a mathematical method to analyze psychological feedback of IPE for college students. After the segments have been created, an STFT is performed on each cut section, creating a spectrum that displays the frequencies present in the time slice. All these elements can be taken into consideration when dealing with the analysis of non-stationary signals, as shown in Equations (2) and (3),

$$\mathrm{STFT}_{w_b}(s,e) = \int w(s)[\int g(s'-s) f^{i2\pi e s'} A_{-b}(s',s) cs']^* cs \tag{2}$$

$$\mathrm{STFT}_{w_b}(s,e) = f^{-I\pi\theta} \int w(s) g^*{}_{-b}(s - \mathrm{scores}\,\emptyset - e\sin\emptyset) f^{-i2\pi s}(e\cos\emptyset - s\sin\emptyset) cs \tag{3}$$

3.4. Analyzing psychological feedback in IPE for college students using hippopotamus-optimized adaptive deep recurrent neural network (HO-ADRNN)

The HO-ADRNN system is essential for controlling the psychological response through the use of biosensors in terms of IPE activities directed toward university youth. The system interprets biosensor input comprising heart, and brain readings' data, and as a result, the HO-ADRNN can determine the emotional state of the subject at various levels, be it stress, motivation, or involvement. The structure provides feedback that is appropriate at each level and modifies the methods of teaching according to the learners' cognitions and affective states. This helps keep the process of learning interesting and the learner's behavior with the parameters that are expected. Then, the optimization feature improves the effectiveness of the intervention design strategy, guaranteeing an effective solution. The network has the possibility, and the network gives a chance for preventive strategies. Its repetition structure also enables the tracking and study of extended emotional behaviors which in turn enhances the students' welfare and productivity. HO-ADRNN is integrated with biosensors and provides noninvasive monitoring and feedback. This shift serves to focus attention on the promise of interactive IPE about aligning psychology education with its objectives. The HO-ADRNN orientation ensures success in both academic endeavors and psychological health.

3.4.1. Adaptive deep recurrent neural network (ADRNN)

A simple modification of the common psychological feedback for college students enables the simulation of consecutive information that constitutes an ADRNN. An ADRNN produces an estimate after receiving a query, updating its concealed nation, and performing a time step. The highly multifaceted concealment underlying the ADRNN and its irregular growth provides considerable expression capacity and allows it to remain concealed from college students' data at several stages to utilize and generate precise projections. Although each component's variability is relatively simple, repeating them multiple times creates tremendously complex movements.

The standard ADRNN was determined as given: taking a value of input vectors $(w_1, \ldots, w_S)$ the ADRNN calculates a value of $(g_1, \ldots, g_S)$ as a hidden value and output vectors as $(p_1, \ldots, p_S)$ by the following iterations for $t = 1$ to T: the standard bidirectional ADRNN is formulated as follow in Equations (4) and (5);

$$g_S = \tan\text{h}\,(X_{gw}w_s + X_{gg}g_{S-1} + a_g) \tag{4}$$

$$p_s = X_{pg}g_s + a_p \tag{5}$$

3.4.2. Hippopotamus optimization (HO)

One of the most popular and advanced bio-inspired metaheuristic optimization methods for handling psychological feedback for college students in IPE issues is the HO. The social change and defense systems of their herds serve as an inspiration for this approach. There are three stages to the HO algorithm; **Figure 3** illustrates the flow chart of HO.

Phase 1: Exploration

This stage seeks to investigate the search area like how hippos navigate their aquatic habitat of psychological feedback. Consequently, the behavior and certain individuals depend on how far away it is from dominating hippos, who represent the optimal option at the moment, other hippos will migrate differently. This distance adds random fluctuations in addition to the hippo's dominance, adding an intrinsic variety to the dynamics of exploration. This method balances exploration and exploitation with the search space in the psychological feedback, enabling a thorough search strategy as expressed by the Equation (6).

$$w_j^{N\,\text{hippo}}: w_{ji}^{N\,\text{hippo}} = w_{ji} + z_1.\,(C^{\text{hippo}} - J1w_{ji}) \tag{6}$$

The location of the male or female hippopotamus is substituted for the dominant position if it yields a higher objective function value than the dominant's present location. This technique guarantees that the inquiry process is constantly searching for more insightful solutions.

Phase 2: The defense action of the hippopotamus against predators (exploration)

This herd goes into defense mode when it detects a potentially dangerous animal, like as a Nile crocodile. Loud vocalizations are indicative of the herd's rapid defensive reaction to the predator. The hippos can react swiftly to the threat because of their rapid thinking. The herd will react in unison as they swiftly turn to confront the assailant. Moreover, the dynamics of this encounter could be affected by the predator's unpredictable movements, which vary with specific limits. The interaction between the predator and the hippos affects how far apart they remain after the defense response, highlighting the herd's tactical moves in dangerous situations as expressed by Equations (7) and (8).

$$\text{Predator}\backslash{:}\,0\backslash{:}\,redator_i \coloneqq V_i + \vec{q}_t.((va_i - V_i), i = 1,2,\ldots,n \tag{7}$$

$$\vec{C} = |O\backslash{:}\,redator_i\backslash{:}-w_j\backslash varvae_i| \tag{8}$$

Phase 3: Hippopotamus escaping from the predator (exploitation)

To avoid major predator attacks or circumstances in which they are unable to mount a sufficient defense, hippopotamuses can escape to more secure locations. The randomization of escape routes is replicated in these unpredictable models. HO would be distinguished by a new location that indicates a successful escape, suggests a stronger solution, and provides a higher objective function result. This method was a cutting-edge technique that considers the difficulty of optimization issues and uses hippos' natural behavior to create an effective search strategy. For the majority of optimization tasks, the approach demonstrates robustness and efficiency through several iterative phases that simulate herd dynamics and defensive mechanisms. Algorithm 1 illustrates the HO-ADRNN.

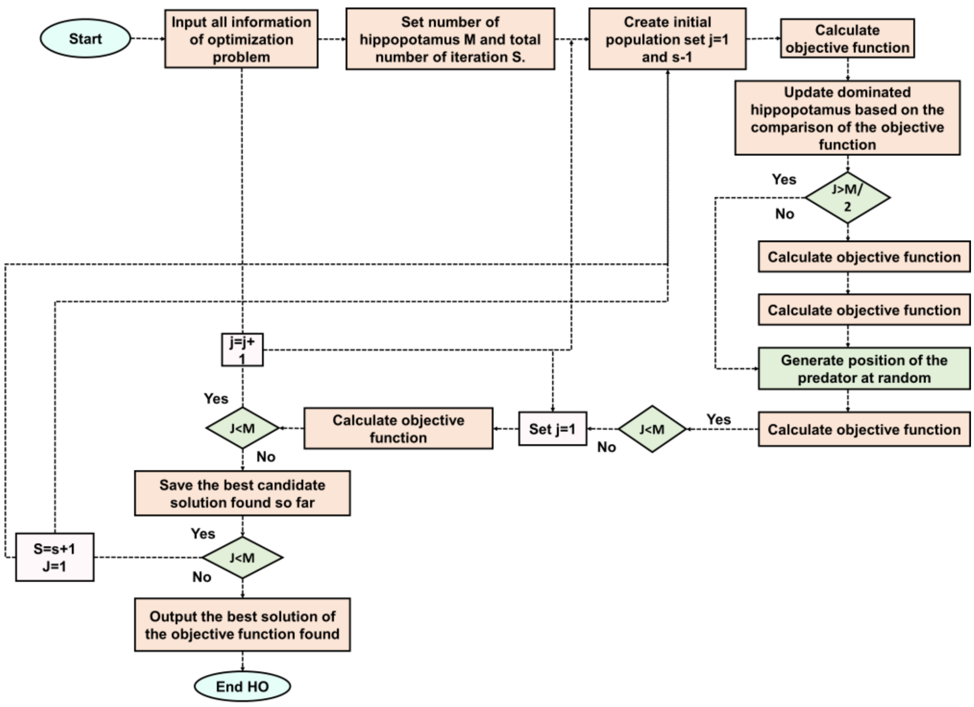

Figure 3. Flow chart of HO.

Algorithm 1 HO-ADRNN

```
// Collect biosensor data
Function collect Data (200 Students):
 Return gathers Biosensor Data (200 Students)
// Pre − process data using Gaussian filter
Function preprocesses Data (college student data):
Return apply Gaussian Filter (college student data)
// Extract features using STFT
Function extracts Features (college student data):
Return apply STFT (college student data)
// Initialize HO − ADRNN model
Function initializes HOADRNN ():
 Return creates HOADRNN ()
// Perform Hippopotamus Optimization
 Function hippopotamus Optimization (HOADRNN, features):
 Explore Search Area (herd, features)
For threat in the environment:
If detect Predator (threat):
Execute Defense Action (hippo)
Escape to a Safe Area (herd)
Function main ():
Biosensor Data = collect college students (200)
 Filtered Data = preprocess Data (biosensor Data)
Features = extract Features (filtered Data)
 Optimized HOADRNN = hippopotamus Optimization
Initialize HOADRNN (), features
// Continuous monitoring of psychological feedback
 While true:
 Adjust Teaching Methods (monitor Psychological Feedback (HOADRNN))
Main ()
```

The initial step involves adumbrating a methodology to build the HO-ADRNN model. The aim is to create a model that can be optimized, and enhanced through training or parameter tuning depending on the needs. This part goes in-depth about how the optimization process imitates the operational dynamics of a behavioral colony of hippos. The function looks for optimal solutions with certain limits. It also explains how an external risk, such as a threat from a predator, comes into play during the switching of states. The herd would go on a defensive position and move to safer grounds, which is a good analogy to describe the optimization process and how it changes states due to perturbations. The last stage deals with the psychological state of learners considering the priming of society in the process of learning. The system does not simply halt after instruction but begins to monitor the student's psychological state and modifies the approach of teaching based on the operation of the HO-ADRNN. This ensures that taught material is continuous and relevant given the circumstances; hence, teaching is adaptive, encouraging better results. The process of optimization enhances the system by exploring the search area, identifying an enemy, and taking cover from the enemy. Psychological feedback is incorporated into the teaching process and the teaching parameters are changed by the results of the optimized model. The feedback process is to maximize the effectiveness of educational techniques approved on previously obtained data.

4. Performance analysis and discussion

The software platform is Python version 3.7 and Visual Studio 2015 with Kinect SDK, the Kinect companion software. In this paper, HO-ADRNN has proposed to evaluate the psychological feedback monitored by biosensors in IPE intervention for college students and existing methods such as convolutional neural network (CNN) [28], CNN support vector machine (CNN-SVM) [28], CNN Back Propagation (CNN-BP) [28], Bi-directional Long Short Term Memory (BiLSTM) [29], BiLSTM Bidirectional Encoder Representations from Transformers (BiLSTM BERT) [29], and BiLSTM BERT Conditional Random Fields (BiLSTM-BERTCRF) [29] and parameters including accuracy, precision, recall and F1 score to compare the effectiveness of the proposed method in assessing the psychological feedback monitored by biosensors in IPE intervention for college students.

4.1. Accuracy

When it comes to IPE interventions among college students, feedback on the use of biosensors is expected to be accurate. Since biosensors provide measurements of hearts, sweat, and brain activities, among others, it helps instructors monitor how absorbed students are being discussed. Such accuracy helps in knowing the student's capacity when such concepts are posed and helps index any issues that can need a change in teaching. Improvement of accuracy of feedback results in economies of time and effort helping educators to determine interventions work and students understanding of the IPE. Besides, accurate information can develop a positive learning context, minimizing barriers to interaction and communication and fostering reflective IPE. Accurate biosensor feedback translates into better IPE engagement strategies by developing an active citizenship approach. As indicated in **Table 1** and **Figure 4** the proposed HO-ADRNN model has a better accuracy of 98.89% than CNN-SVM (96.83), CNN-BP (97.31), and CNN (97.83). This shows that HO-ADRNN is better in terms of accuracy in the monitoring of biosensors on psychological feedback which made it a better educational intervention in terms of ideological and political education for college students.

Table 1. Quantitative values of accuracy.

Methods	Accuracy
CNN-SVM [28]	96.83
CNN-BP [28]	97.31
CNN [28]	97.83
HO-ADRNN [proposed method]	98.89

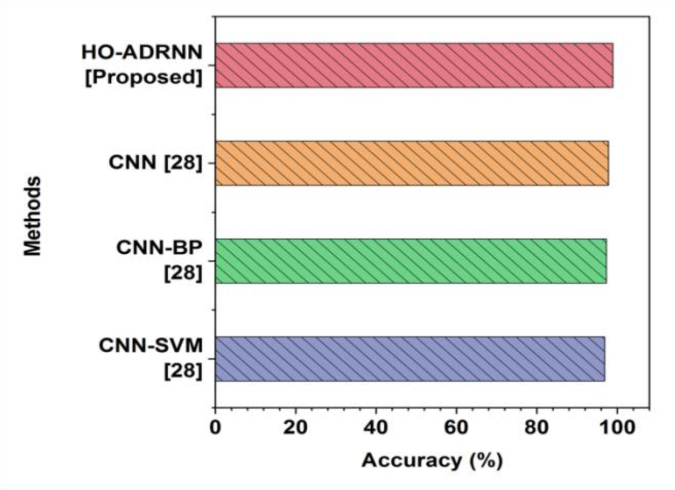

Figure 4. Graphical representation of accuracy.

4.2. Precision

In the IPE of college students, psychological feedback-controlled biosensors are crucial for ensuring precision. With biosensors becomes possible for an educator to collect objective and real-time information about students, such as HRV and EEG. This precision is reutilized to cover emotional and cognitive aspects that need to be addressed for psychological feedback. Moreover, precise feedback mechanisms are capable of determining in times of stress or engagement peaks, so that teaching methods can be modified. The use of precise feedback integrates for better understanding of students' psychological characteristics but also more efficient and flexible teaching. Therefore, this promotes changes in the IPE, the development of critical thinking, active participation, and the relationship between psychological state and involvement in the IPE of the students. **Table 2** and **Figure 5** show that the proposed HO-ADRNN model has a precision of 98.89% outcompeting other methods. It achieved higher precision than the CNN model (97.82%), BiLSTM-CRF model (85.87%), and BERT-BiLSTM-CRF model (91.63%). This shows that HO-ADRNN is significant in properly measuring the psychological feedback received from the bio-sensors in the aspect of ideological and political education interferences towards college students.

Table 2. Quantitative values of precision.

Methods	Precision (%)
CNN [28]	97.82
BiLSTM-CRF [29]	85.87
BERT-BiLSTM-CRF [29]	91.63
HO-ADRNN [proposed method]	98.89

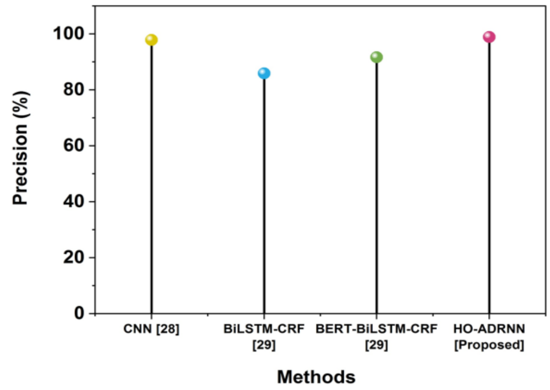

Figure 5. Graphical representation of precision.

4.3. Recall

Recall in the provision and assessment of psychological feedback, is monitored by biosensors, especially during some IPE interventions targeted at college students. The use of biosensors, the participants' physiological changes in HRV, and information concerning the student's emotional attachment and cognitive activity levels are obtained during the learning processes. Recall is central to the evaluation of acquisitions in ideological messages by the students in the course of interventions. The retention of information can suggest the success of content and methods. Additionally, the use of recall in assessment provides for a change of level or type of instruction by the teacher in response to students, increasing effectiveness and learning. This kind of relationship encourages a broader perspective of IPE beliefs and ideologies as the students are actively encouraged to think and react, as illustrated in **Figure 6** and **Table 3**, the proposed HO-ADRNN has a recall value of 98.96% and outperforms CNN (97.83%), BiLSTM-CRF (85.45%), and BERT-BiLSTM-CRF (90.56%) in supervising psychological feedback from biosensors regarding ideological and political education of college students. This significant improvement underscores the enhanced capability of the proposed HO-ADRNN in accurately identifying correct psychological patterns for feedback purposes.

Table 3. Quantitative values of recall.

Methods	**Recall (%)**
CNN [28]	97.83
BiLSTM-CRF [29]	85.45
BERT-BiLSTM-CRF [29]	90.56
HO-ADRNN [proposed method]	98.96

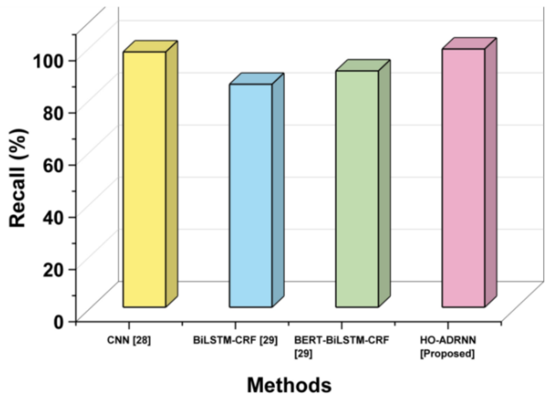

Figure 6. Graphical representation of recall.

4.4. F1 score

F1 score has significance when determining the efficacy of psychological feedback registered by biosensors during interventions targeted at college students' IPE. This is quite beneficial in an educational atmosphere whereby the students' emotional and cognitive behavior can help design interventions to make them stronger in society. A high value of the F1 score means that the feedback system can distinguish the students' emotional states, which are important in adapting the teaching approach and improving student collaboration in IPE. In addition to the F1 score, it assists in determining the confidence level that can be placed on biosensors in data reliability, ensuring the veracious use of interventions. While these scores allow refinement of IPE by educators, they provide an environment conducive to learning. **Table 4** and **Figure 7** show the value of the f1-score for the HO-ADRNN model is 94.05%, surpassing the performance of existing methods. Specifically, BiLSTM achieved an f1-score of 83.02%, BiLSTM-CRF reached 85.09%, and BERT-BiLSTM-CRF had 91.09%. This shows that HO-ADRNN is significant in properly measuring the psychological feedback received from the bio-sensors in the aspect of ideological and political education interferences towards college students.

Table 4. Quantitative values of F1 score.

Methods	**F1 score (%)**
BiLSTM [29]	83.02
BiLSTM-CRF [29]	85.09
BERT-BiLSTM-CRF [29]	91.09
HO-ADRNN [proposed method]	94.05

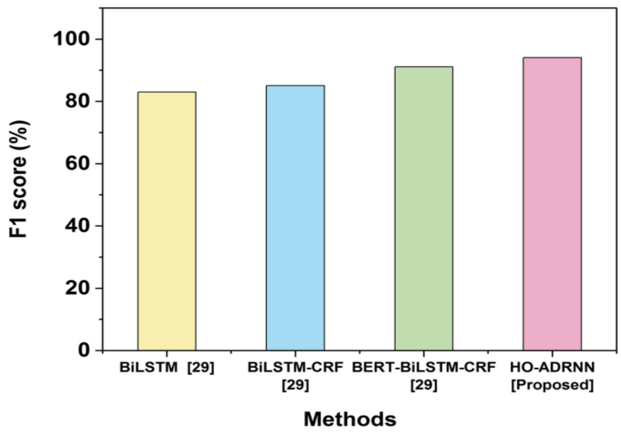

Figure 7. Graphical representation of F1 score.

4.5. Assessing psychology feedback factors

The study of factors affecting psychological feedback is essential for the biosensor monitoring of psychological feedback in the course of the formation of IPE beliefs in college students. This assessment indicates the emotional and cognitive response of the students allowing modifications based on individual or group feedback, while also providing a projection of their responses. The instructors can understand students' levels of attention, anxiety, and willingness to accept the information offered by the instructor through measuring physiological parameters like HRV, and EEG data. This data-driven strategy makes it possible to determine particular psychological hurdles that can obstruct productive learning as well as ideological embrace. In addition, the assessment of feedback factors aids in the modification of instructional methods designed to increase the effectiveness of the interventions. It encourages a more flexible learning setting and children's psychological conditions are not static. Ultimately, the introduction of psychological feedback mechanisms with the educational processes improves care for the essence and ideologies of students as well as their mental health as diverse needs of emotions are satisfied at appropriate times. It also encourages a better educational experience, which in turn makes the IPE of college students more necessary and significant. **Table 5** and **Figure 8** highlight HO-ADRNN's performance in quantitative values of psychological feedback factors during educational interventions. It performs well in assessing behavioral engagement and motivation (90%) but shows moderate accuracy for cognitive load (65%) and stress/anxiety levels (43%), with emotional response and social interaction at 75%.

Table 5. Quantitative values of psychology feedback factors.

Factor	HO-ADRNN (%)
Emotional response	75
Cognitive load	65
Stress and anxiety level	43
Behavioral engagement	90
Motivation and satisfaction	90
Social interaction	75

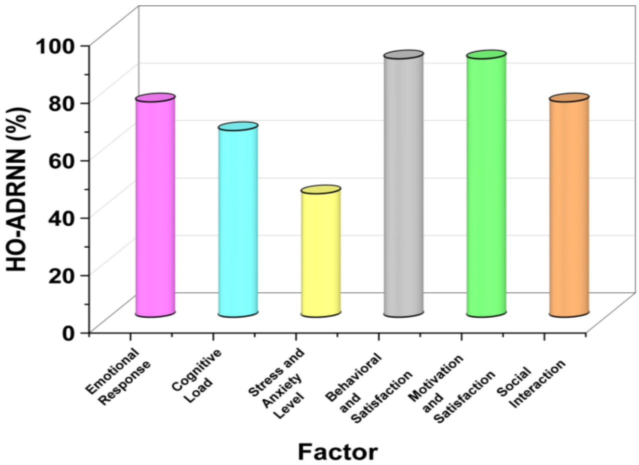

Figure 8. Graphical representation of psychological feedback factors.

4.6. Discussion of this study

The use of biosensor-administered psychological feedback in IPE for college students transforms teaching by offering real-time insights during activities. Educators can adjust strategies on the spot to meet diverse learning needs, enhancing engagement and addressing cognitive challenges. Monitoring stress and involvement levels ensures that instruction aligns with students' psychological states, creating a supportive learning environment. This dynamic approach not only fosters students' critical thinking and practical skills but also aids in their personal and emotional development. By encouraging students to reflect on their experiences, the integration of psychological feedback promotes meaningful learning and the formation of political ideas, making it a vital element in modern education. The imperceptible alterations of college students' data can deceive CNN [28], thus creating the issue of security and robustness when applicable in sensitive cases. The inclusion of SVM in CNN-SVM [28] increases the training time and complexity of the process, which makes it difficult to use in real-time situations. The CNN-BP [28] technique has the problem of a heavy computational burden, particularly when deep architectures are involved, making time time-consuming and resource-demanding in training processes. While initializing Bi-LSTM [29] models, one can have to impose some weight prerequisites. If ignored, these requirements will lead to either failure to converge or convergence to a non-optimal region of the search space. BiLSTM-BERT [29] models make BERT simple and easy to use, but they are memory and time-consuming systems during training and inferring the output. BiLSTM-BERT CRF [29] takes a lot of processing resources, which makes it difficult to use the approach in production on low-powered devices or for real-time applications. The proposed method of HO-ADRNN has overcome the challenges faced by the existing methods and boosts the expected accuracy by adjusting specific parameters via reaction surface methodology in monitoring the psychological feedback of college students. It achieves this by adapting effectively to changes in data patterns over time, making it well-suited for time series prediction. The model cuts down the time taken to train the machine while keeping performance at a maximum level in the case of performance optimization. Also, it enhances generalization, reducing overfitting which helps in making consistent and accurate predictions over different sets of data.

5. Conclusion

The effects of biosensors on college students' IPE activities and the use of psychological feedback, monitoring the students' emotions and cognition in the teaching-learning process using biosensors, in improving teaching and learning methodologies. This unique feature helps the teacher to monitor the emotional and cognitive levels of students in real time and develop effective methods of teaching that raise the interest and comprehension levels of students. The proposed method of HO-ADRNN has achieved 98.89% in Accuracy, 94.91% in Precision, 93.96% in Recall, and 94.05% in F1 score. The psychological barriers again; focus on creating a pleasant atmosphere that encourages students to think and act instead of passive learning. Ensuring monitoring of the feedback helps to increase the effectiveness of kinds in educational interventions but also supports an environment where dialogue and questioning are encouraged. Also, it helps with the emotional health and personal growth of learners as it caters to their different psychological aspects. The implementation of psycho-corrective techniques is necessary for carrying out sustainability and effective IPE. Individuals exhibit differences in physiological responses; the findings cannot be generalized, making it difficult to utilize the knowledge over different populations of students. Individual variations in physiological reaction, incomplete comprehension of emotion, and short-term assessment are a few of the difficulties. Technology dependence and issues with the ethical use of information also present other difficulties. Additionally, the psychological feedback received is often inconsequential and does not focus on addressing barriers or disabilities, and also the lack of contextual influence makes it difficult to use in various cultures and educational settings. An interesting aspect of future empirical research can be concerned with the use of AI together with machine learning algorithms for biosensor data exploration. Also, it would be helpful to conduct longitudinal studies to explore the effectiveness of educational interventions about biosensor-monitored feedback on patterns of students' development in IPE participation.

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