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Article

Evaluation model of physical education teaching effect based on machine learning algorithm with biomechanical integration

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Abstract: This study aims to propose a machine learning-based approach to assess the impact of physical education instruction, integrating biomechanical principles to addressing the challenge of difficult and inconsistent result evaluation. The evaluation index system is constructed based on key factors influencing teaching quality, including teaching attitude, content delivery, instructional methods, and teaching effects, with an added emphasis on biomechanical metrics such as movement efficiency, joint kinematics, and muscle activation patterns. This paper suggests a Biomechanically Enhanced Physical Education based Dwarf Mongoose Optimization Algorithm (PE-DMOA) for the advancement of PE, leveraging ML technology and biomechanical analysis to optimize PE teaching strategies. We pre-process the physical education dataset, incorporating biomechanical data from motion capture systems, force plates, and electromyography (EMG), alongside traditional teaching metrics gathered information from 2150 students and 72 teachers across various schools, to predict learning efficiency more accurately than previous methods. With a student satisfaction rate of 95.6%, the experimental results confirm the efficiency of the evaluation model developed in this article. The study's results show that the suggested model (PE-DMOA) is 98.5% accurate. This means that it helps to look into the effects of machine learning and biomechanics on physical education teaching and gives good recall, accuracy, and precision results. Educators and learners can utilize the PE-DMOA evaluation model to enhance the quality and efficiency of instruction, streamline administrative tasks, and advance the scientific, standardized, and specialized delivery of physical education in classrooms.

Keywords: physical education; teaching effect; machine learning; biomechanics; physical education based dwarf mongoose optimization algorithm (PE-DMOA)

1. Introduction

With society moving quickly forward, the change of effect education is getting an increasing amount of focus. The reform of teaching Physical Education (PE) in schools is an ongoing process of exploration and advancement. The impact of classroom instruction is becoming more and more significant in the eyes of experts and scholars. Over the last ten years, there has been a steady increase in the popularity of different sports in school health and fitness programs. Teaching physical activity in the classroom is becoming increasingly important to schools, and this impact must be measured using unique evaluation metrics. As such, it is imperative to develop indices that align with evaluating the impact of PE instruction in the classroom. Algorithms for machine learning have been progressively incorporated into the field of education due to their ongoing development. The way that physical education (P.E.) is taught in schools has changed significantly in recent years, and this has improved the students' overall competencies. Traditional sports theory ignores the psychological impact and

all-around ability of students in favor of emphasizing the teaching of theoretical knowledge in the context of education [1].

China is a major country in higher education because of its "speed." Nonetheless, China's higher education development is now hampered by the synchronized growth of effect enhancement and expansion in scale. The main strategy for advancing curriculum reform and subject innovation in China's education system is to combine the core literacy system with subject instruction [2]. The decline in the physical appearance of kids in school has become an undeniable fact in recent years. Even though school physical education does not directly cause young students' physical decline, it can undoubtedly improve a lot of kid's physical fitness if done well. The standard way to teach physical education, which only focuses on teaching facts and skills, is not suitable for this. The 2022 Report Card examined sedentary behaviors among Chinese students, assigning a grade of C due to a limit of 2 hours per day. Boys (51.2%) were more sedentary than girls (46.1%). Older students were more likely to be sedentary. The 2022 Report Card's benchmark and assessment instrument changed, excluding homework time and changing the time cut-off. The percentage of sedentary behaviors slightly increased from 92.9% in 2018 to 93.0% in 2022 [3]. About 10% of education in China is still done in classrooms with teachers providing their full attention. Students' position of power is weakened by teacher-led instruction; they accept information passively and lack the motivation to actively engage in the learning process. Its foundation is found in the influence of conventional content- and teacher-centered teaching theories [4]. Education is an interesting area that is always growing and has a big effect on everyone's life. Several times, methods and approaches for making major-impact learning events have been talked about, starting with classroom instruction and moving on to e-learning [5]. The difficulties with traditional physical education include low student participation and physical fitness, a lack of suitable space for practical skill development, inadequate facilities and sporting goods, and a lack of physical education instruction.

The goal of machine learning (ML) technology is to investigate how to simulate or simulate animal learning behavior on a computer. Its goals are to improve program performance, reorganize the current data structure, and gain new knowledge or abilities. From a statistical standpoint, machine learning is applied by forecasting the distribution of data and building a shape from the information. Next, the model is used to forecast fresh data. Therefore, it is necessary that the distribution of the test and training data match. The most popular uses are in natural language processing (NLP) and computer vision. Higher education must include physical education (PE). High-effect physical education promotes school students' overall development. The contents, forms, means, and modes of physical education in schools have all changed as a result of the application of numerous contemporary concepts and techniques to higher education technology, and a machine learning algorithm is used in school physical education classes to help students learn better and have better overall skills. This is done to make up for the problems with traditional college physical education classes and to use psychological education theory in school physical education classes. It is important for the mental growth of PE kids and the improvement of their overall skills [6].

The primary goal of the physical education curriculum is to help students develop the fundamental skills necessary for major learning in the subject. Examples include the development of students' strategies, skills, and movement effect; the enhancement of sports classroom learning; and the development of students' culture in sports, knowledge in sports, and communication in sports, as depicted in **Figure 1**.

Figure 1. Physical education major learning.

The outcome of the proposed methods is compared with other popular optimization techniques, such as Random Forest (RF) [7], Naïve Bayes (NB) [8], Support Vector Machine (SVM) [9], and Principle Component Analysis (PCA) [10], on the studied issues. The outcomes demonstrated that the recommended method is capable of finding fresh, ideal answers to the two tested problems. The rest of this essay is shown as follows: Section 2 contains a discussion of the related paper's background. In Section 3, the methodology of the proposed Physical Education Dwarf Mongoose Optimization Algorithm is illustrated. The result experimental details and analysis are presented in Section 4. Section 5 outlines the conclusion of the project.

2. Related study

1) Three key indicators of the success of physical education are the growth of students' intellectual capacity, theoretical knowledge, and physical fitness. According to the author, the conventional techniques for assessing the efficacy of physical education that rely on teachers' knowledge are not measurable or statistical, and they are also unfit for assessing the efficacy of body studies [11].
2) The evaluation index system for the teaching of physical education impact is made up of three types of middle schools, each with its own unique regional traits. These are a city,the area, and the countryside middle schools. Some of the less important things that showed how well students did were their ability to learn, their ability to express themselves, their knowledge of and ability to use knowledge in sports, their ability to evaluate, their need for protection and help,

their learning time, their cooperative spirit, their mental state, and their ability to reach their goals [12].

3) Through questionnaire surveys and interviews, researchers examined higher secondary school PE teachers and discovered issues with social adaptation, mental health, sports participation, and sports skills, among other areas. The assessment subject is not comprehensive, and Teacher and student evaluations are the only ones used; there is no connect to student evaluations of each other [13].
4) This paper aim is to make a time difference for learning representation of video under self-supervision. They presented a novel approach to learning representation of video with graph convolutional networks and time-contrast learning. They carried out a number of tests to show Tcgl's efficacy in a range of video comprehension tasks and to underscore its promise for self-supervised learning of representation with video [14].

- This study analysedthe Secondary school students' using qualitative comparative analysis on online learning platforms. They investigated what factors, in addition to platform design and user behavior, influence secondary school students' purpose to stick with platformin onlineeducation [15].
- The authors present a study that evaluates the intensity of public opinion in online crises using a multilevel system. They talked about the implications of their multilevel approach for handling and reacting to crises in online public opinion [16].
- From the standpoint of teaching activities, the quality of physical education at Guangxi Province's colleges and universities was evaluated. Each related index was given a weight, and the ranking system was established with a sum of 100 points. In order to assess the physical education efficiency, four levels were measured [17].
- The Naïve Bayes (NB) algorithm is used in this study to assess college students' physical fitness and enhance the excellent of PE instruction. The outcome demonstrated that the technique on attributes with different category was able to achieve 81.02% of the physical rate. The accuracy attained was 82%, and every student received a different training scenario [18].
- The study focused on the pedagogical of PE through the use of an improved random forest (RF) classifier implemented in a scalable, technique within a wireless environment in energy routing. Increased strength, speed, and quality are produced by the analyzed attributes of over three thousand students, with a 94.6% involved student engagement level, 90% quality of PE teaching, precision 96.7%, recall 98.2%, and f1-score 98.1%. The suggested approach is unworkable for obtaining improvement offline because it has only been chosen for online instruction [8].
- The study defines a novel approach for predicting PE scores that combines a deep neural network based on principal component analysis (PCA) with a factory method that takes the student's standard level into account. The results of assessing the effectiveness of PE instruction and students' learning yielded recall scores of 95%, accuracy of 86.6%, precision of 86.8%, and area under the curve

of 82.9%. There were relatively few attributes that were analyzed in order to predict students' performance based on the quality of instruction [19].

3. Methodology

3.1. The current state of physical education instruction

Numerous areas require improvement, regardless of whether the evaluation is conducted before or after the curriculum reform regarding the mentor effectiveness of PE classes.

First, the only things that can be used to judge the quality of physical education instruction are the conceptual framework that has been built and the lack of empirical study on behavior in the classroom. This is a top-down theoretical explanation that doesn't use real facts from the classroom to back it up. These assessment standards and metrics are not valid and reliable enough [20].

Second, there is only one evaluation method—primarily qualitative evaluation—and no quantitative evaluation. It is more typical to create index systems and standards for evaluating the quality of instruction in the classroom, then allocate the kilogram of the corresponding ranking systems. Such a pound distribution lacks a scientific basis for distribution and is highly subjective. It is not a substantive tool for evaluating classrooms; rather, it is merely a theoretical framework that does not adequately capture the details and impact of in-class instruction. Furthermore, the individuality of classroom instruction is not reflected in these evaluation index structures; rather, they merely convey the commonality of classroom instruction. There are a lot of different personality types that work together to make teaching in a school changing, open, and creative.

As a result, we cannot use the same benchmark to evaluate every class. Furthermore, there is not any study on how the evaluation standards and indicators affect teaching in the classroom, and the standards and indicators aren't often used to judge the quality of teaching in the classroom.

While China has developed numerous standards and indicator systems for evaluating PE classroom instruction over the years, these have only been necessary for the assessment of open and superior courses. The role of evaluation in promotion has not been used, and these evaluation standards and ranking systems are not used by teachers to guide their real lessons. The focus of the new physical education curriculum is on evaluation feedback and incentive roles as well as its ability to advance students' growth, teachers' advancement, and instructional quality. Teaching feedback and fostering the growth of both teachers and students require a precise, impartial, and thorough depiction of classroom teaching behavior. This study creates a new way to measure the effects of PE teaching in the classroom using machine learning. This is necessary because we can only really understand and judge classroom teaching by carefully observing and writing about it. We can then provide feedback and improve classroom teaching.

A general look at the state of physical education in China shows that 91% of physical education teachers think the outer layer is important. On the other hand, 52% of teachers and 45.2% of students think that the current physical exam is not necessary.17.57% of teachers and 25.22% of kids think the physical exam is important.

92% of respondents believed that school physicals were crucial. This study looks into the physical education instructors and learners at an alternative school.

3.2. Data preprocessing

Based on the material of the evaluation of physical education conducted in the classroom, the current state of Physical health tests for kids and teachers in physical education in five schools was examined and assessed. Each school had six physical education teachers chosen, and the teacher survey looked at over 72 teachers. 2150 students are chosen from among all the schools, taking into account the proportion of male to female students as well as the count of students in male and female. **Table 1** represents the dataset description.

Table 1. Dataset description.

Dataset	Description	Measurement		
		Elementary (1–5th Class)	**Middle (6–9th Class)**	**High (10–12th Class)**
Age	Age range of student	6–10	11–14	15–16
Gender	M—Male/F—Female	M/F	M/F	M/F
Weight	Students weight in kg	18–30 kg	30–50 kg	50–65 kg
Height	students height in cm	109.2–138.4 cm	143.5–163.8 cm	163–175.2 cm
BMI	Body Mass Index BMI=$\frac{weight}{height^2}$	Normal: 18.5–24		
Sprint	Running in a short distance at high speed in meters	7.5–6.5 m/s	6.5–4.5 m/s	4.0–3.5 m/s
Long Jump	complete longest forward jump	2–4.5 m	4.5–5.76 m	5.76–6.91 m

Evaluation Content: **Table 2** shows that when evaluating physical education teachers approach, how they teach, motor abilities, morality, and guidance are the main things that are being looked at. Evaluations of teachers' skills, their ability to teach and do study, student engagement, and the atmosphere in the classroom are not given as much weight. While processing the data cleaning in students records 150 records are removed as duplicate and invalid data. Using the drop_duplicates() function in the Pandas library in Python, duplicate rows and columns were removed, and Boxplot with outliers was used to handle the missing values. The ratio is calculated based on the formula:

$$\text{Ratio for teachers: } \frac{Number\ of\ vote\ count\ of\ participant}{Total\ number\ of\ Teachers} \times 100,$$

$$\text{Ratio for Students: } \frac{Number\ of\ vote\ count\ of\ participant}{Total\ number\ of\ Students} \times 100.$$

Table 2. Evaluation of P.E.

Content for Evaluation	Teacher (number = 72)	Ratio (%)	Students (number = 2000)	Ratio (%)
Teaching method	30	41.66	879	43.95
Teachers motor skill	29	40.27	823	41.15
Creativity of teachers	35	48.61	978	48.9
Teachers scientific research ability	28	38.88	856	42.8
Class atmosphere	38	52.77	1058	52.9
Teachers attitude towards teaching	26	36.11	983	49.15
Teachers effect of teaching	29	40.27	783	39.15
Level of students involvement	10	13.8	634	31.7

Feedback:72 physical education teachers participated in a questionnaire survey, and the results were subjected to multiple voting sessions. The study's findings indicate that 5 schools cast votes on the evaluation results following an assessment of the students' physical education instruction. Student sports are the primary content, according to the input content (**Table 3)**. Tests of fitness, mental ability, talents, activities, in regular classes are all factors in the physical education score. As a result, students find it challenging to identify their strengths and their weaknesses in the feedback, and the content of the forum is inconsistent. Network feedback primarily provides the outcome of the students' assessment of the physical education instruction in five different schools.

Table 3. Content on feedback.

Feedback	Teacher (number = 72)	Ratio (%)	Students (number = 2000)	Ratio(%)
Sports	23	31.94	834	38.79
Advantage and disadvantage of learning	8	11.11	423	19.67
Improve on New strategy	5	2.77	387	18.00
Encouragement	15	20.83	785	36.51
Unknown	10	13.88	682	31.72

3.3. Physical education based dwarf mongoose optimization algorithm (PE-DMOA)

The DMOA method is a population based metaheuristic, mathematically formulated on the foraging and social behavior of dwarf mongoose animals. The behavioral reaction to make up for it dwarf mongoose is replicated by the proposed PE-DMOA and is modeled as follows.

3.3.1. Alpha strategies group

Once the students strength is initiated, the efficiency of each solution is computed. The likelihood value is determined by Equation (1), and the alpha students gender is selected in accordance with this likelihood.

$$\alpha = \frac{fit_i}{\sum_{i=1}^{n} fit_i} \tag{1}$$

The students count in the α is represented by the $n - bs$. Where peep is the vocalization of the dominant students gender that keeps the students on course, and bs is the number of babysitters. The following is the strategies for updating the solutions.

$$X_i{+}1 = X_i + ph_i \times peep \tag{2}$$

where a distributed random number ph_i is used. Equation (3) gives the every criteria as it does, but after every iteration, where phi is a distributed random integeruniformly [1, 1].

$$si_m = fit_{i+1} - fit_i / max[|fit_{i+1} - fit_i|] \tag{3}$$

The average number of teaching strategies found is provided by Equation (4).

$$\varphi = \frac{\sum_{i=1}^{n} si_m}{n} \tag{4}$$

The next learning source or resting PE is taken into consideration during the scouting stage of the algorithm, which begins when the criterion is satisfied with babysitting exchange.

3.3.2. Scout group

If the physical education learning forages far in the scout group section, they will find a good criteria for fitness. Equation (5) simulates the scout mongoose.

$$\mathrm{x_{i+1}} = \begin{bmatrix} \mathrm{X_i} & -\mathrm{CF} \times \mathrm{Pn} \cdot 1 \times \mathrm{rand}_{\left[\mathrm{x_i} + \vec{\mathrm{M}}\right], \mathrm{if}\varphi\dot{\Gamma}} \\ \mathrm{X_i} - \mathrm{CF} \times \mathrm{Pn} \cdot 1 \times \mathrm{rand}_{\left[\mathrm{x_i} - \vec{\mathrm{M}}\right], \mathrm{oth}} & \end{bmatrix} \tag{5}$$

CF value is determined by Equation (6), and rand is a random value of the range from [0,1] where$\vec{M}$value is determined by Equation (7),

$$CF = \left(1 - \frac{\dot{Liter}}{Max_{iter}}\right).^{\left(2 \times \frac{iter}{Max_{iter}}\right)} \tag{6}$$

$$\vec{M} = \sum_{i=1}^{n} \frac{x_i \times sm_i}{X_i} \tag{7}$$

Usually lower-class group members, babysitters stay with the kids and are rotated regularly so the alpha students gender can lead the rest of the squad on daily learning expeditions.

The instructor-based subsystem looks at the effect on learning from the point of view of school officials and PE teachers. These classes look at how the following things affect PE training and student learning based on the idea of multiple intelligences: providing resources, planning the curriculum, teaching in the classroom, doing practical teaching, and changing the way teachers do their jobs. Among them,

resource provision shows how good the software and hardware are and how skilled the faculty and staff are in the PE major; curriculum planning shows how logical and systemic the PE major is; classroom teaching shows how well the basic knowledge of the PE major is taught to students; practical teaching shows how well the learning environment and hands-on experience are combined; and teaching reform shows how creative the PE major is. These things led to the creation of the teacher-based section (**Table 4**).

Table 4. Instructor based learning effects.

Task	Criteria	Index	Meaning
T11	Resource Provision	Ability in teaching Ability in Administrator	Effects on education and teaching effect
T12	Curriculum Planning	Progress control Teaching content	Logical intelligences
T13	Teaching in Classroom	Strategy in teaching Classroom environment Attitude in teaching Teaching Skills	Effects on multi-level intelligences
T14	Real life practice	Innovative Critical thinking General service Co-ordination	Interpersonal Intelligence
T15	Teaching Reform	Reform ability PE participation	Naturalist intelligences

The advantage of proposed method PE-DMOA randomly creates and improves a set of physical education teaching solutions for a certain optimisation problem by using the exploratory and exploitative abilities of DMOA, which are similar to the seminomadic behaviour and compensating adaptation of the dwarf mongoose.

A new novel PE-DMOA with Learning Strategy (LS) is presented in this section to address various mathematical benchmarking functions and physical education difficulties. To improve the searching capabilities, the novel proposed solver incorporates an enhanced LS, whose process of updating is partly led by the revised alpha. To improve the searching performance, the LS is combined with the Equation (3) to produce a energy position with potential. Because of this, the following changes have been made to the physical education of each search result in the search space:

$$D_{k,d}(i+1)=\begin{cases} BestDM_d(i)+\text{rand}(0,1)\times\left(D_{k,d}(\text{i})-D_{R,d}(\text{i})\right) if_{ELse}^{rand<CP} \\ D_{k,d}(\text{i})+\text{rand}(0,1)\times peep \\ k=1{:}\,N_{DM}-\text{Best},\text{d}=1{:}\,\text{Dim} \end{cases} \quad (8)$$

where CP stands for the choice probability, $D_{k,d}$is a selected in random searching particular from the DM population, and $BestDM_d$indicates the alpha regarding the searching particular person with the best fitness score. To create a balance between

the enhanced qualities with exploitation indicated in Equation (8) and the exploration features provided in Equation (3), CP is set to 50%. While utilizing the previously mentioned structure, the exploitation features are significant and robust, and at the same time, the qualities isexploratory seeking are maintained and obtained through the conventional method. **Figure 2** represents the proposed model of the study.

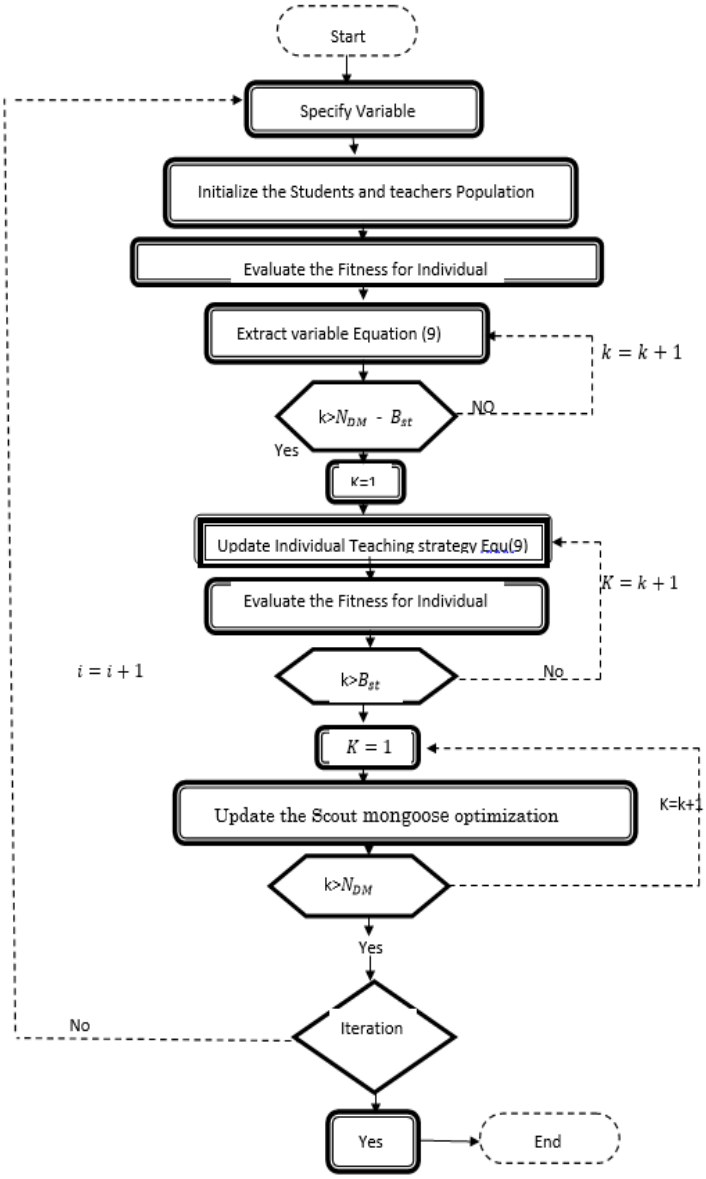

Figure 2. Flow chart for proposed model.

4. Results and discussion

Experimental setup: The proposed PE-DMOA is evaluated through explorations that are performed on MatlabR2024a platform and the results of which are presented in the subsequent sections together with other relevant analysis. The efficiency of the proposed PE-DMOA method is confirmed using the original classification algorithms, such as RF, NB, SVM and PCA. The effectiveness of physical education teaching effect should be measured using different metrics like recall, accuracy, precision, and F1-score.

Table 5 shows the physical education teaching performance for the following student grades: elementary for class 1 and 5, middle-school for class 6 and 9, and High school for class 10 and 12. The tasks are iterative. Using a DMOA and PE-DMOA, performance analysis of effective instruction is made. Both tactics are applied in similar situations. The average is used to quantify the results. The two outcomes based on DMOA and PE-DMOA for the corresponding statistical outcome tasks are displayed in **Table 4** and **Figure 3**, respectively. It is evident that the suggested PE-DMOA is stronger in terms of achieving the lowest average in over 60% of the benchmark function.

Table 5. Statistical outcome of DMOA and PE-DMOA.

Task	Standard DMOA				Proposed PE-DMOA			
	Elementary (1–5th Class)	Middle-school (6–9th Class)	High (10–12th Class)	Average (%)	Elementary (1–5th Class)	Middle-school (6–9th Class)	High (10–12th Class)	Average (%)
T11	14	34	23	58.34	17	38	55	85.31
T12	26	23	18	54.23	28	45	41	77.34
T13	15	43	33	68.75	17	47	45	82.56
T14	3	28	25	45.15	5	31	58	71.72
T15	15	20	18	32.91	20	62	41	68.10

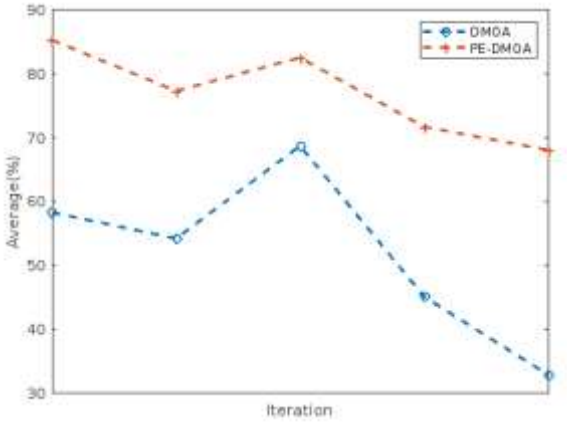

Figure 3. Evaluation of DMOA and PE-DMOA.

Comparative Analysis with criteria:

Table 6. Comparative analysis.

Task	RF (%)	NB (%)	SVM(%)	PE-DMOA [Proposed] (%)	PCA(%)
T11	84.03	64.23	72.31	85.31	73.06
T12	73.34	57.61	70.34	77.34	71.23
T13	81.02	65.05	79.81	82.56	78.54
T14	69.83	59.91	63.41	71.72	60.52
T15	63.10	55.12	59.52	68.10	61.81

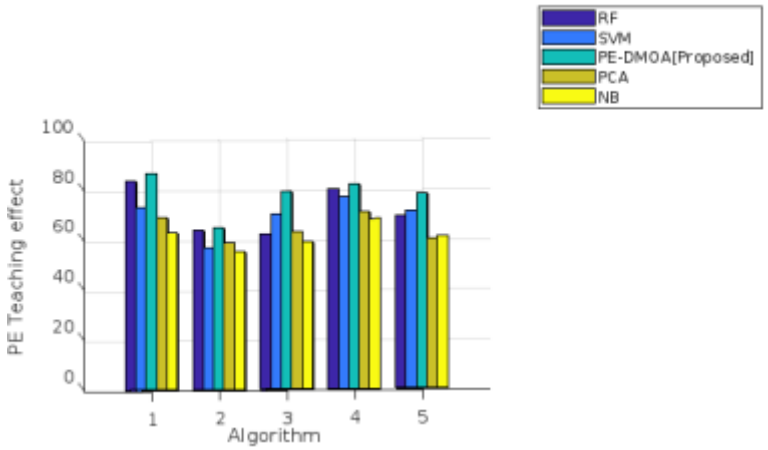

Figure 4. Comparison of algorithms.

The comparative analysis of the results with the algorithm approaches is shown in **Table 6** and **Figure 4**. Compared to other models, the PE-DMOA approach performed better in each of the four categories, with an average improvement of about 1.5%. Furthermore, the PE-DMOA model showed excellent accuracy in assessing satisfaction with students, participation ranking, and physical fitness, with scores of 85.31%, 77.34%, 82.56%, 71.72%, and 68.10%, respectively. ML models, such as RF, SVM, PCA, NB, and the proposed PE-DMOA model, were used to assess the dataset. The purpose of this study is to determine whether the physical actions enjoyment scale and other cutting-edge techniques for gauging students' satisfaction with physical activity are suitable for adult learners.

4.1. Accuracy

In order to evaluate Physical education effect based on Machine Learning, we use a range of measure, such as recall, accuracy, precision and F1-score. We compare these performance metrics with the existing methods such as RF, NB, SVM and PCA.

The percentage of incidents that are reliably and effectively classified is analyzed by accuracy. **Table 7** and **Figure 5** show the accuracy's outcome. Our suggested approach had a higher PE-DMOA (98.5%) percentage than the current methods, which are RF (91.2%), NB (82.6%), SVM (86.8%), and PCA (89.1%). When compared to existing approaches, the proposed approach, PE-DMOA, has significantly improved physical education effectiveness prediction.

Table 7. Outcome value of accuracy.

Classification Method	Accuracy (%)
RF	91.2
NB	82.6
SVM	86.8
PCA	89.1
PE-DMOA [Proposed]	98.5

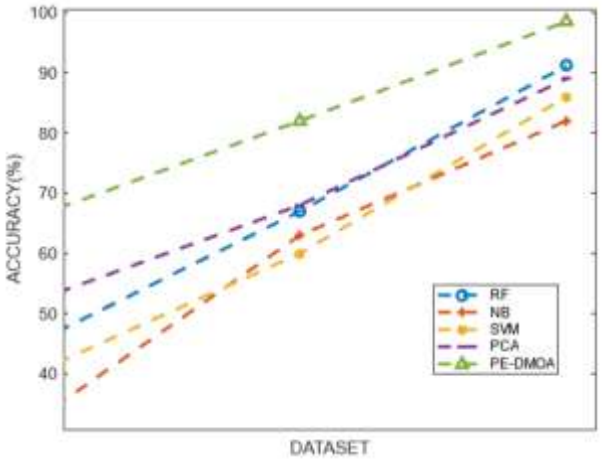

Figure 5. Outcome of accuracy.

4.2. Precision

The efficiency of the PE teaching system is measured by this statistic. In this paper, we utilize 2150 students. **Figure 6** shows that while the precision of the current techniques (RF, NB, SVM, and PCA) has been demonstrated to be less than 80%, the precision of our suggested approach, PE-DMOA, has been demonstrated to be 97.3% higher than that of the previous techniques. **Table 8** and **Figure 6** show the precision's outcome. When compared to existing approaches, the proposed approach, PE-DMOA, has significantly improved physical education effectiveness prediction.

Table 8. Outcome value of precision.

Classification Method	Precision (%)
RF	89.2
NB	80.6
SVM	82.9
PCA	88.0
PE-DMOA [Proposed]	97.3

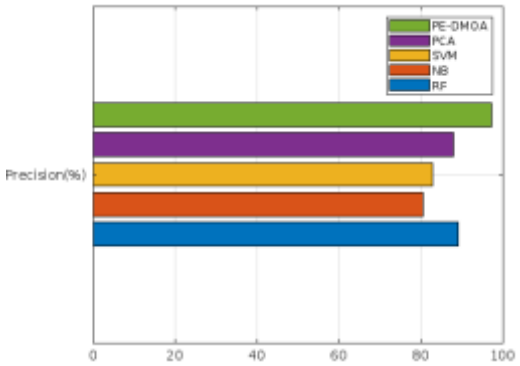

Figure 6. Outcome of precision.

4.3. Recall

Recalls show the percentage of true positives that are effectively acknowledged out of all real positives. **Figure 7** and **Table 9** illustrates the result of the recall.

Compared to the existing method RF (92.1%) NB (84.6%), SVM (86.2%), PCA (89.3%) Our proposed method was higher PE-DMOA (98.2%). The proposed approach, PE-DMOA, has significantly improved Physical education learning effectiveness prediction when compared to current methods

Table 9. Outcome value of recall.

Classification Method	Recall (%)
RF	92.1
NB	84.6
SVM	86.2
PCA	89.3
PE-DMOA [Proposed]	98.2

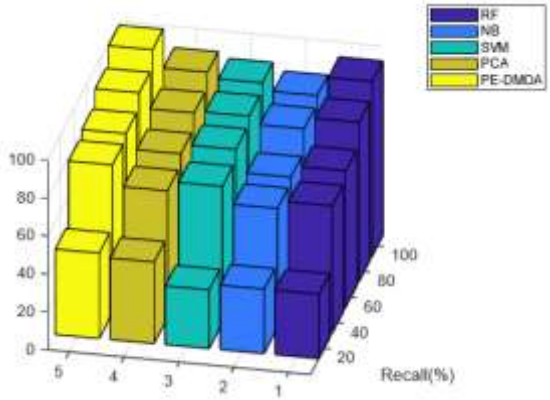

Figure 7. Outcome of recall.

4.4. F1-score

The efficiency of the physical education teaching system is measured by this statistic. **Figure 8** and **Table 10** shows a comparison of the present classification methods and the suggested classification methods in terms of F1-score. **Figure 6** and **Table 6** illustrates the result of the F-Measure. Compared to the existing method RF (89.2%), NB (80.6%), SVM (82.9%), and PCA (88.0%) Our proposed method was higher PE-DMOA (97.3%). The proposed approach, PE-DMOA, has significantly improved physical education teaching effectiveness prediction when compared to current methods. **Table 11** represents the comparison of different evaluation methods.

Table 10. Outcome value of F1 score.

Classification Method	F1-Score (%)
RF	89.2
NB	80.6
SVM	82.9
PCA	88.0
PE-DMOA [Proposed]	97.3

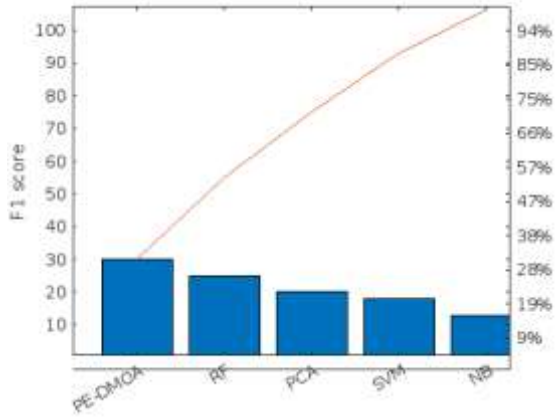

Figure 8. Outcome of F1 score.

Table 11. Comparison of different evaluation methods.

Methods	Accuracy (%)	Precision (%)	Recall (%)	F1 score (%)
Fuzzy set	82.65	80.37	81.83	80.89
PSO	85.02	83.56	83.82	84.93
BSO	88.54	87.82	88.11	87.83
MLTLBO	90.82	89.56	90.34	90.01
LSTM	90.87	89.76	90.20	90.00
RNN	91.25	90.24	91.05	89.95
PE-DMOA	98.69	96.56	97.67	97.21

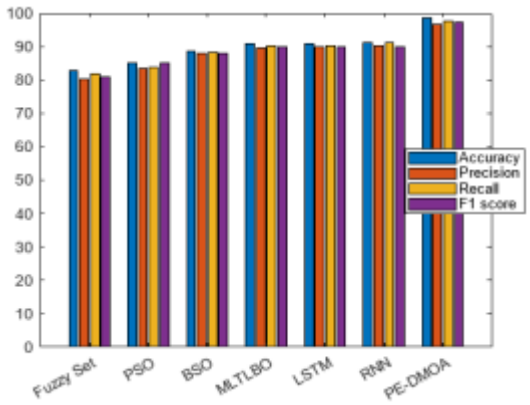

Figure 9. Outcome of the different methods.

Compare the various approaches to the suggested method and provide precise numerical results on the same data set to assess the physical education instruction. These findings should include accuracy, precision, recall, and F1 score. **Figure 9** of the comparison illustrates the accuracy of the fuzzy set at 82.65%, PSO at 85.02%, BSO at 88.54%, MLTLBO at 90.82%, LSTM at 90.87%, RNN at 91.25%, and PE-DMOA at 98.69%, which is the highest accuracy.

4.5. Learning satisfaction with students

The student's work is graded, and the measure of student happiness is compared to other methods that have been used before. The comparison of student happiness is

shown in **Figure 10**. Using the suggested PE-DMOA method instead of the existing ones, 95.6% of students were much happier with it than the existing methods.

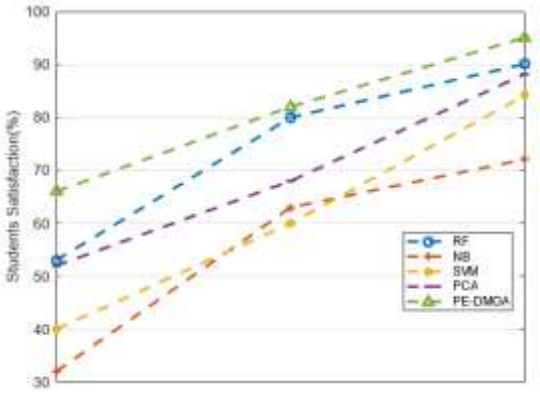

Figure 10. Outcome of learning satisfaction with students in methods.

5. Conclusion

This essay first examines the challenges associated with determining the impact of Physical Education (PE) on learning, a significant issue in schools, and subsequently proposes strategies for selecting the appropriate measurement. We developed an evaluation method for the learning effect based on the theory of multiple intelligences, considering the perspectives of both teachers and students. According to the study, schools have a critical role in encouraging children and adolescents to engage in physical activity. Based on factors such the main concern, the frequency and length of physical education, certified teachers, facilities, equipment, and student happiness, 28% of Chinese children and adolescents received a Grade D. The grade from the 2018 Report Card did not change. Given that children spend over half of their day in school, the study highlights the need of giving school-related PE issues top priority. The proposed method PE-DMOA, Using pre-processing we are able to anticipate learning efficiency with greater accuracy than previous approaches by utilizing the data collected from 2150 students and 72 teachers. The experimental results display that the suggested strategy is effective, outperforming ML methods in phrases of accuracy (98.5%), precision (97.3%), recall (98.2%), and F1 score (97.3%). This research improves educational practices and promotes improved learning outcomes. Future research suggests consolidating, enhancing, and strengthening physical education. To enhance the rigor and scientificity of the classroom teaching quality evaluation index system, future research may employ specific approaches.

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