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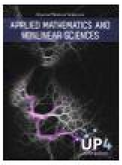

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Systematic integration of information big data and physics teaching based on deep learning algorithms

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Abstract

This paper first investigates the main performance of the shackles of traditional physics teaching on students and its negative consequences and then designs a physics teaching process model based on the teaching environment of information big data and constructs a framework of the physics teaching system by utilizing data mining technology. Then the physics teaching system is modeled based on the artificial neuron model and recurrent neural network, and the attention mechanism is used to improve the overall generalization performance of the model. Finally, the application effect of the physics teaching system is comparatively analyzed through empirical evidence. The results show that there is a deviation in the mean value of the two classes, the average score of the experimental class is 75.552 points, and the average score of the control class is 65.910 points, and there is a difference of 9.642 points between the two classes' mean values. The data show that the application of a physics teaching system can improve the learning status quo of students' mechanical imitation, help students better master knowledge, enhance students' ability to use information technology and achieve better teaching results than traditional teaching.

Keywords: Information big data; Physics teaching; Deep learning; Attention mechanism; Teaching system
AMS 2010 codes:

1. Introduction

With the advent of the cloud era, big data has also attracted more and more attention, and its application in the field of education has gradually become the focus of attention in the reform of education and teaching [1-2]. In this context, the high school physics course needs to realize a major change from the traditional mode to the information-based teaching mode in the new round of curriculum reform [3]. The impact of information big data on education is extremely profound. One is that information technology scientifically and rationally guides

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our teaching and students' learning, and the other is that the educational activities in the environment of information big data are rich and colorful [4-5].

The high school physics subject occupies an important position in the whole high school learning life of students, and mastering good problem-solving habits and perfect physics ideas can lay a good foundation for students' future growth and development [6-7]. Making full use of the development results of big data technology and information technology, realizing the deep integration of information technology and high school physics teaching, so that the presentation of physics course knowledge can be more image, specific and vivid so that the process of teaching high school physics courses can become more high-quality and efficient [8-10]. Therefore, how to realize the integration and application of information big data and physics teaching has become the key to teaching nowadays [11-12].

In order to solve the problem of how teachers choose virtual laboratories when teaching, literature [13] analyzes the scope, design and characteristics of virtual laboratories, describing their target audience, design features, scope and details, the level of experimental analysis, proximity to reality and user-friendliness. Literature [14] studies the application of modern educational technology in physics teaching, describes its possibilities and prospects in physics teaching, analyzes its advantages and disadvantages, and through teaching experiments, the results show that the application of modern educational technology improves the efficiency of teaching and learning in the physics classroom. Literature [15] investigated the correlation between general knowledge, interest and personality with attitudes and perceived competence in physics teaching and learning through an experimental test with 196 teachers. The results showed that interest was highly correlated with teachers' confidence in teaching physics and technology topics.

In addition, the literature [16] believes that active learning can improve students' academic performance and skill ability and takes the undergraduate physics majors of Lanzhou University as an example of free radical suspension polymerization, and the results show that the proposed learning method can provide students with a satisfactory learning experience, improve scores and promote skills. Literature [17] believes that experiment is the focus of physics teaching and plays a vital role in university physics, a virtual physics experiment teaching platform is constructed based on B/S three-layer structure system and MVC mode, and the results show that the constructed platform can assist students to operate physics experiments better through the platform test and student satisfaction analysis. Literature [18] in order to study the innovation of educational methods, the UPCT-Bloopbusters educational program was carried out in Physics I, Applied Physics and Optical Communication, and by analyzing the success rate and academic results of students before and after applying the new method, the results showed that the educational program could improve the academic performance of students.

This paper researches the system integration of information big data and physics teaching, firstly analyzes the current physics teaching status quo from the main performance of the shackles of traditional physics teaching on students and the negative consequences it brings, and designs a physics teaching process model. Secondly, the data mining process is analyzed, and the physics teaching system framework is constructed. Then the concept of deep learning was elaborated, and the teaching system model was built based on deep learning, artificial neuron model, recurrent neural network and attention mechanism. Finally, a teaching case was designed and developed and applied in the seventh-grade physics classroom of Z Middle School using the experimental research method. The results show that the application of the physics teaching system in the physics classroom can improve the learning status quo of students' mechanical imitation, can help students better master knowledge, enhance students' ability to use information technology, and can achieve better teaching results than traditional teaching.

2. Construction of Physics Teaching System in the Context of Information Big Data

2.1 Current status of physics teaching

Traditional education, also known as “duckling education” or “education to the test”, has favorable conditions for imparting basic knowledge, which is conducive to the acquisition of systematic and rigorous cultural and scientific knowledge in a relatively short period of time. But the cultivation of students should be in all aspects, not simply pass on knowledge to students can be. There are some problems in the traditional teaching mode that affect the normal development of students’ quality in all aspects. The shackles of traditional physics teaching on students are mainly manifested in the following aspects:
(1) Treating knowledge as definitive and as a dead dogma.
(2) Disdaining the students’ existing cognitive ability.
(3) Neglecting the differences among learners.
(4) Equating the learning process with the input process of knowledge from outside to inside.
(5) Over-simplification of the teaching process.
Under the sway of the above teaching concepts, traditional teaching has shown many weaknesses, leading to a series of negative consequences:
(1) Lack of interest in learning.
(2) Lack of independence and autonomy in learning.
(3) Weak thinking ability.
(4) Difficulty in the flexible application of what has been learned.

2.2 Physics Instructional Design Process Model

The current study of “learning”-centered instructional design theory, along with the popularity of constructivism, is attracting more and more attention, especially in the teaching and learning environment of big data. The application of “learning”-centered instructional design theory has its unique The soil. The principles of learning-centered instructional design are summarized as follows:
(1) Emphasize student-centeredness.
(2) Emphasize the design of the learning environment.
(3) Emphasize the use of various information resources to support “learning”.
(4) Emphasize the important role of “context” in the construction of meaning.
(5) Emphasize the key role of “collaborative learning” in the construction of meaning.
(6) Emphasize that the ultimate goal of the learning process is to complete the construction of meaning.
Usually, we use the process model of instructional design to briefly illustrate the basic process of instructional design activities. Figure 1 shows the process model of physics instructional design.

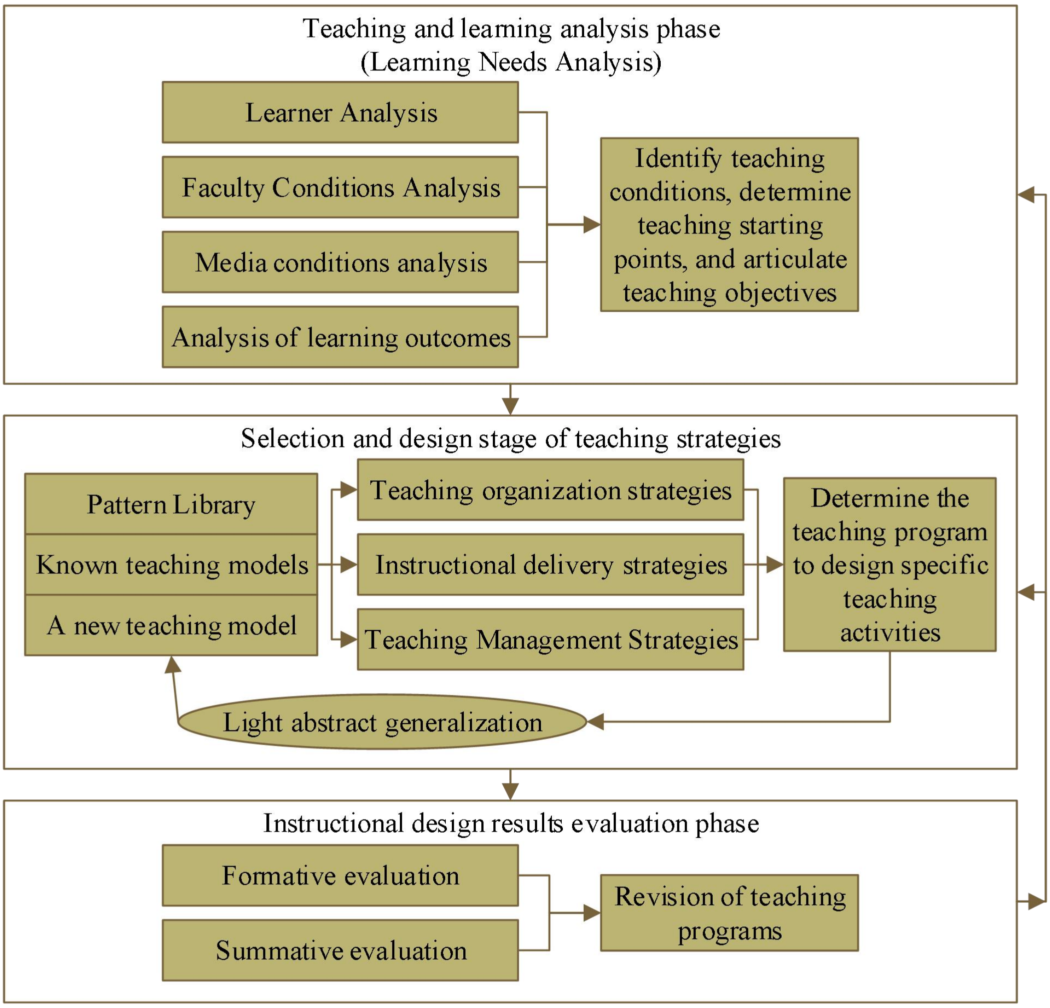

Figure 1 Physics teaching design process model

2.3 Data mining process

Data mining is an interdisciplinary branch of computer science that allows for the discovery of patterns and computational processes on large datasets from the intersection of artificial intelligence, machine learning, statistics and database approaches. The overall goal of data mining is to extract information from datasets and transform it into comprehensible structures for further use rather than just analyzing the data itself. Data mining is commonly used in large-scale data and information processing aspects, as well as in decision support system applications. The information processing aspects include data collection, data cleaning, data storage, data transformation, data analysis and knowledge representation, and the decision support system applications include artificial intelligence, machine learning and business intelligence. Figure 2 shows the basic process and main steps of data mining. Currently, commonly used data mining techniques include artificial neural networks, genetic algorithms, decision trees, clustering, regression, association rules and so on. The research in this paper happens to use the artificial neural network technique.

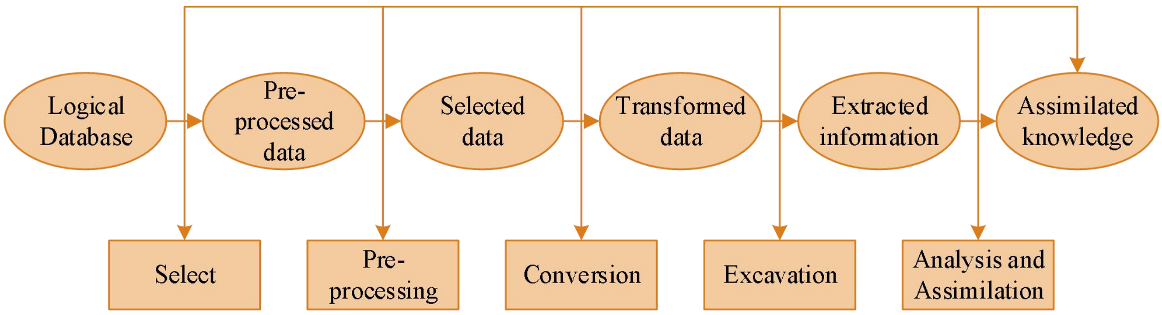

Figure 2 Basic process and main steps of data mining

2.4 Constructing a systematic framework for teaching physics

Based on the above analysis of the physics teaching model and the process of teaching physics, the physics teaching analysis system was designed in this section. Figure 3 shows the general structure of the physics teaching system.

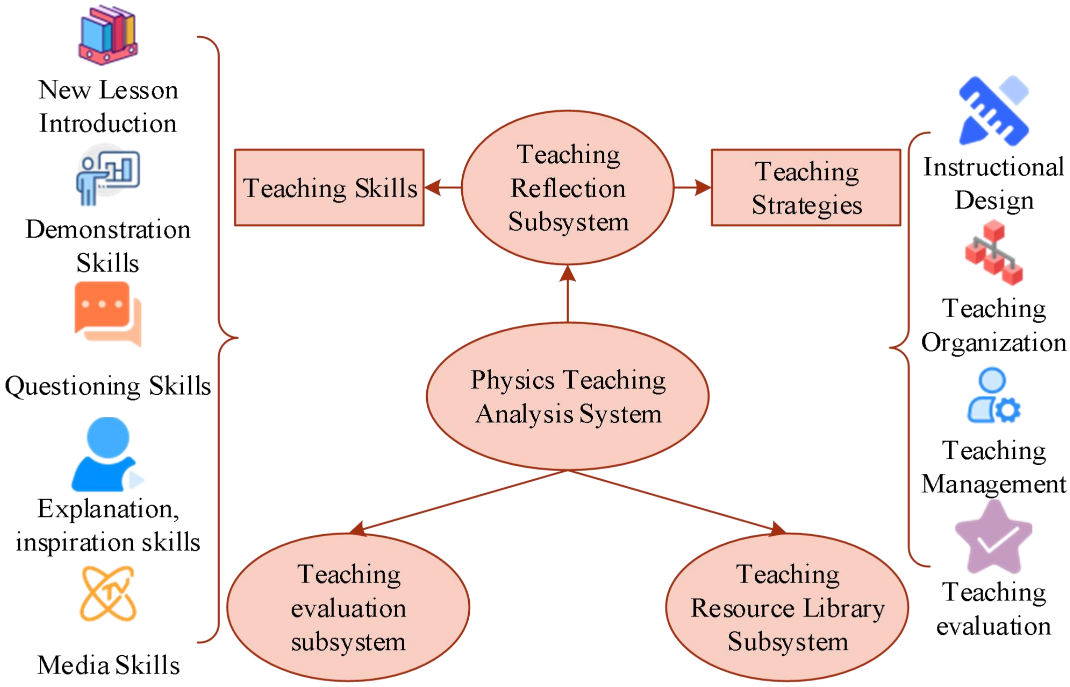

Figure 3 General structure of physics teaching analysis system

3. Model of physics teaching system based on the deep learning algorithm

3.1 Deep Learning

With the continuous advancement of curriculum reform, deep learning in the field of education has received widespread attention. Deep learning not only refers to cultivating students' higher-order thinking but also emphasizes the development of students' literacy. Combining the views of several scholars, this study proposes that deep learning is a process in which learners, on the basis of knowledge mastery, use multiple strategies or methods to actively learn knowledge and complete the construction and understanding, integration and transformation, and transfer and application of knowledge to create, so as to achieve the understanding of knowledge, the enhancement of ability, and a good emotional experience. Table 1 shows the results of the comparison between deep learning and shallow learning. Through the comparison of deep learning and shallow learning, we know that deep learning has the characteristics of focusing on critical thinking, emphasizing knowledge integration, focusing on transferring and applying, advocating reflection and evaluation, and is oriented to problem-solving and developing higher-order thinking.

Table 1 Comparison results of deep learning and shallow learning

	Deep learning	Shallow learning
Learning motivation	Own need	External pressure
Memory mode	Comprehension memory	Simple repetition, mechanical memory
Learning engagement	Engage actively and maintain attention for a longer period of time	Attention cannot focus for long periods of time
Learning style	Active learning.	Passive learning
Learning objective	Master knowledge and solve problems	Acquire knowledge
Knowledge system	Integrated, connected	Isolated, scattered
Reflective ability	Actively reflect and monitor the learning process	The learning process lacks reflection and evaluation
Migration application	Be able to draw parallels	Inoperable
Thinking level	Higher order thinking	Lower order thinking

3.2 Artificial Neuron Modeling

(1) Mathematical model of neuron

Take the j st neuron as an example, $(x_1, x_2, \ldots, x_n)$ is the n-dimensional input vector, w_{ij} is the weight connection between the nodes in the INPUT layer and the HIDDEN layer, the size of the weights and the positive and negative values are used to represent the synaptic strength and the two states of excitation and inhibition, and the weight vector is the $(w_{1j}, w_{j2}, \ldots, w_{jn}), f(\bullet)$ is the activation function of the function, and the y_i is the actual output value of the node.

There are two states of neuron, activation state or inhibition state, which are represented by positive and negative 1 respectively. The output of neuron j can be expressed as:

$$y_j = \operatorname{sgn}\left(\sum_{i=1}^{n} w_{ij} x_i - \theta_j\right) \tag{1}$$

Where θ_j is the action threshold of the j nd neuron, and the expression for sgn is:

$$y_j = \operatorname{sgn} = \begin{cases} +1 & \sum_{i=1}^{n} w_{ij} x_i > \theta_j \\ -1 & \sum_{i=1}^{n} w_{ij} x_i \le \theta_j \end{cases} \tag{2}$$

Where x_j denotes the i nd dimensional input vector, w_{ij} denotes the weight values of neurons i to j, θ_j denotes the threshold value of neuron j, y_j denotes the output value of neuron j, and $f(\bullet)$ denotes the transfer function of the neuron.

When the activation level of neurons N_j is greater than the threshold θ_j, it has an excitatory effect on the network, and when the activation level of neurons N_j is less than or equal to the threshold θ_j, it has an inhibitory effect on the network.

(2) Transfer function of neurons

In the neural network topology, each hidden layer contains a number of numbers of neuron nodes, and when information processing is performed, the relationship between the output of these nodes and their activation state is reflected through the transfer function, which is usually also referred to as the activation function. As the connotation of biological neurons to transfer information is extremely rich, with different transfer functions to establish artificial neuron models, then the network's ability to process the input data is also different. Therefore, it is particularly important to select a suitable transfer function. Different equations can be used for the transfer function of neurons, and the following types are more commonly used:
(a) Linear functions
The activation function f is a continuous value taken over the real number field, and y increases as x increases. The output of the function and its derivatives are relatively simple continuous functions that are relatively easy to implement in hardware. The linear function expression is:

$$f(x)=x \tag{3}$$

(b) Segmented function transfer function
The segmented function in different intervals expression is not the same. It is in the threshold function on the basis of the further improvement of the extension. Segmented linear function in the hardware implementation is relatively simple. Its expression is:

$$f(x)=\begin{cases}0 & x\leq 0\\ cx & 0<x\leq x_c\\ 1 & x_c<x\end{cases} \tag{4}$$

(c) S-functions
This type of function is a non-decreasing continuous function on the real number field R, which acts as an interval restriction on the output of an artificial neuron. The S-functions are divided into unipolar and hyperbolic tangent functions, where the hyperbolic tangent function is symmetric, and the unipolar function is structurally asymmetric. Their expressions are:

$$f(x)=\frac{1}{1+e^{-x}} \tag{5}$$

$$f(x)=\frac{1-e^{-x}}{1+e^{-x}} \tag{6}$$

Since the S-type mathematical trait is very similar to the physiological properties of biological neuron models, it is widely used as an excitation function for neuron models in artificial neural networks.

3.3 Recurrent Neural Networks

Recurrent Neural Networks are a class of network models for processing time series data, and the basic RNN consists of three parts: the input layer, the hidden layer, and the output layer. The front and back hidden layers of a CNN are connected by a weight w, so that the inputs of the hidden layer are not only related to the inputs of the current moment t but also to the outputs of the moment $t-1$, and thus the RNN uses the inputs stored in the previous layer to help make the current decision. In this way, the RNN uses the input information saved in the previous moment to help the current decision, and the final model has the ability to process long sequences of text. In addition, weight w is shared among different hidden layers, which ensures that the number of parameters of the model will not be very large, and there will not be the problem of parameter explosion.
LSTM has the ability to solve long-term dependency problems and has achieved great success in many fields. LSTM replaces the internal storage mechanism of recurrent neural networks with a single-cell state. Compared to RNN, which only passes state to one hidden layer,

LSTM has an extra cell state that first splices the input x_t of the current model with the output Z^t, Z^f, Z^i, Z^o of the previous hidden state, and then performs a different computation of the splicing result to get four brand new states h_{t-1}. Results are computed differently to get four brand new states 3.

$$Z^t = \tanh\left(w_t\left[x_t; h^{t-1}\right]\right) \tag{7}$$

$$Z^i = \sigma\left(w_i\left[x_t; h^{t-1}\right]\right) \tag{8}$$

$$Z^f = \sigma\left(w_f\left[x_t; h_{t-1}\right]\right) \tag{9}$$

$$Z^o = \sigma\left(w_o\left[x_t; h_{t-1}\right]\right) \tag{10}$$

Z^f is the "forgetting gate" of LSTM, which selectively forgets the previous state C^{t-1} through Z^f, forgetting those useless information and remembering only the useful information. Z^i is the input gate of LSTM, its main function is to selectively memorize the input Z^t at the current moment t, the important information in the input will be recorded, and those irrelevant secondary information will be remembered less, so as to finally obtain the expression of C^t as:

$$C^t = Z^f \odot C^{t-1} + Z^i \odot Z^t \tag{11}$$

The final output of the model is controlled by the control gate Z^o, which first effectively deflates the cell state at the previous moment using the Tanh function, mapping it to a value between $[-1,1]$ and finally the dot product of Z^o and this value yields the final output, h^t, which has the following expression:

$$h^t = Z^o \odot \tanh\left(C^t\right) \tag{12}$$

GRU, on the other hand, optimizes the LSTM by converting the three gating mechanisms of the LSTM into two, namely, replacement gating and update gating.GRU first obtains the two gating states, replacement gating r and update gating z, by using the output h_{t-1} of the previous moment and the input x_t of the current moment, with the expression:

$$r = \sigma\left(w^r\left[x_t; h_{t-1}\right]\right) \tag{13}$$

$$z = \sigma\left(w^z\left[x_t; h_{t-1}\right]\right) \tag{14}$$

After obtaining the two gated states, the model applies a substitution gate to reset the hidden state h_{t-1} of the previous moment to h'_{t-1}, then splices h'_{t-1} with the input x_t of the current moment, and then maps the result of the splicing between $[-1,1]$ through a Tanh function to obtain the hidden state h'_t of the current moment. The most unique thing about GRU compared to LSTM is that GRU completes the function of forgetting and input gate in LSTM by only using update gating z. $(1-z)\odot h_{t-1}$ corresponds to the forgetting gate in LSTM, GRU will selectively forget the hidden state of the previous moment, and $z \odot h'_t$ corresponds to the input gate in LSTM, and through the input gate, GRU can selectively memorize the inputs h'_t of the current moment, so it can be seen that GRU combines the selection and forgetting through the change of z and (1-z) and the two are linked to each other, which is computed in the following formulas:

$$z = \sigma\left(w^z\left[x_t; h_{t-1}\right]\right) \tag{15}$$

$$h'_t = \tanh\left(w^t\left[x_t; h'_{t-1}\right]\right) \tag{16}$$

$$h_t = (1-z)\odot h_{t-1} + z \odot h'_t \tag{17}$$

Whether it is RNN or LSTM, the model predicts the output of the next moment based on the previous temporal information, but in some problems, the output of the current moment does not only depend on the state of the previous moments but also relates to the state of the moments that follow. A bidirectional recurrent neural network consists of two repeated modules superimposed on top and bottom. The module can be an ordinary RNN, LSTM or GRU. Take RNN, for example. The output of the t st moment is determined by the output of the forward RNN of the t nd moment and the output of the reverse RNN of the t rd moment together. Meanwhile, the model has six unique weight parameters that are constantly utilized at each moment, where w_1 and w_3 transform the input data into the inputs of the forward and backward hidden layers after linear transformation, while w_2 and w_5 are used for the interconversion between the forward and backward respective hidden states, and finally, w_4 and w_6 are used for the mapping between the forward and backward hidden layers to the output layer.

3.4 Attention mechanisms

How to make the model effectively learn the important generalized features in the data becomes the key to improving the overall generalization performance of the model. In order to improve the generalization ability of the model, it is necessary for researchers to improve the existing network model structure without excessively increasing the complexity of the model. The attention mechanism is based on this idea, the model, through a series of algorithms gets the weight matrix calculated by the feature map, the size of the weights indicates the importance of the feature, so that it can achieve the purpose of highlighting the important features and suppressing the interference features The modeling mechanism is based on this idea.

The attention mechanism model inputs the input sequence $x=\left(x_1,x_2,\ldots,x_n\right)$ into the encoding layer, the encoding layer of the model consists of a recurrent neural network, after the recurrent neural network to get the hidden state $h_j, j\in[1,n]$, in the decoding layer, the hidden state H_i at the current moment is jointly determined by the output of the hidden state at the previous moment and the input of the decoding layer at the current moment y_i, $i\in[1,m]$, and then the similarity calculation of h_j and H_i can be obtained to get the attention scores, and then finally the attention weight can be obtained by going through a Softmax function, and the expression formula is:

$$S\left(h_j,H_i\right)=H_i^T h_j \tag{18}$$

$$\alpha_{ij}=\text{softmax}\left(S\left(h_j,H_i\right)\right) \tag{19}$$

In addition, the similarity between h_j and H_i can be calculated using formula (18) in addition to the product, splice, and additive attention calculations with the formula:

$$S\left(h_j,H_i\right)=H_i^T w_H h_j \tag{20}$$

$$S\left(h_j,H_i\right)=w_H\left[H_i;h_j\right] \tag{21}$$

$$S\left(h_j,H_i\right)=V^T\tanh\left(w_1 H_i+w_2 h_j\right) \tag{22}$$

After obtaining the weights of the attention mechanism, the model can weigh and sum the attention weights with the hidden states in the encoding layer as part of the inputs in the decoding layer at moment t. In this way, the model can fully dig out which hidden states in the decoding layer at the current moment t actually pay attention to the hidden states in the coding layer and ignore those unimportant ones directly, which is calculated as follows:

$$c_t = \sum_{j=1}^{n} \alpha_{ij} h_j \tag{23}$$

4. Analysis of the effect of applying the physics teaching system

In this chapter, on the basis of following the model of the deep learning-based instructional system constructed above, the instructional case was designed and developed and applied in the seventh-grade physics classroom at Z Middle School using the experimental research method. The deep learning-based instructional system was applied to the subject of physics for two parallel classes of seventh grade 7 and 8 students in Middle School Z. A teaching experiment was conducted for more than two months to verify the effectiveness of the instructional system constructed in this study in facilitating the occurrence of deep learning for students in the physics classroom.

The students of Grade 7, Class 8 and Class 9 of Secondary School Z were used as the study subjects, with the number of students in both classes being 60, 33 males and 27 females in Class 8, and 26 males and 34 females in Class 9, with essentially the same types of students and basic levels. To control the effect of other extraneous variables, both classes were taught in the same laboratory and by the same teacher.

4.1 Comparative analysis of deep learning capabilities

(1) Pre-test

Before the teaching practice was formally carried out, in order to understand the deep learning ability of the students in the two classes, 100 test papers were distributed in class 7 and class 8 of grade 7, and 97 valid test papers were recovered, of which 49 were in the experimental class, and 48 were in the control class. After that, the data were analyzed by SPSS, and based on obeying the normal distribution, the data of the two classes were subjected to the independent samples t-test, and Table 2 shows the results of the analysis of the dimensions of deep learning ability.

Table 2 Analysis results of each dimension of deep learning ability

Dimensionality	Classes	Mean value	Standard deviation	Standard error of the mean	Importance	Importance (two-tailed)
Mastery of core knowledge	Experimental class	23.30	4.943	.715	.724	.316
	Control class	22.28	4.870	.709		.316
Critical Thinking and problem solving	Experimental class	30.16	6.085	.880	.991	.390
	Control class	28.17	5.989	.873		.390
Learning to learn	Experimental class	15.03	3.601	.520	.019	.276
	Control class	15.72	2.498	.371		.274
Perseverance in learning	Experimental class	15.72	3.297	.479	.738	.280
	Control class	15.02	3.011	.440		.280
Teamwork skills	Experimental class	19.58	4.176	.606	.824	.481
	Control class	19.00	4.460	.652		.481
Communication skills	Experimental class	16.00	3.014	.439	.500	.080
	Control class	14.91	2.718	.396		.080

It can also be seen from the data in Table 2 that there is not much difference between the means of the two classes in the dimensions of deep learning ability, and the experimental class has a higher mean value than the control class in the mastery of core knowledge, perseverance in learning, and teamwork and communication ability, while the mean value is lower than that of the control class in the dimensions of critical thinking and problem solving, and learning to learn. Analyzing the data in Table 2, it can be obtained that the P-value in the dimension of learning to learn is 0.019, which is less than 0.05, and the Sig of the observed t-test is 0.274, which is greater than 0.05 without satisfying the chi-squaredness, so the difference is inferred to be insignificant, and the P-value and the Sig of the rest of the dimensions are all greater than 0.05, which also indicates that the two classes do not have a significant difference in the dimensions and that the in-depth learning abilities are basically comparable and a controlled experiment can be conducted.

(2) Post-test

The focus of the post-test is to analyze whether the deep learning ability of the experimental class has been improved before and after the teaching practice by comparison. So, after the teaching experiment, the deep learning ability test papers were issued to the students of class 7 and class 8 for post-testing. A total of 100 test papers were issued, and 95 valid test papers were recovered. SPSS was used to analyze the data of each dimension of the post-test of the deep learning ability of the two classes, and Table 3 shows the results of the independent sample t-test of each dimension of the post-test of the deep learning ability of the two classes.

Table 3 Independent sample t-test for each dimension of the posttest in both classes

Dimensionality	Classes	Mean value	Standard deviation	Standard error of the mean	Importance	Importance (two-tailed)
Mastery of core knowledge	Experimental class	25.03	1.605	.231	.037	.002
	Control class	23.76	2.193	.321		.002
Critical Thinking and problem solving	Experimental class	30.40	4.701	.683	.207	.353
	Control class	31.80	3.616	.534		.352
Learning to learn	Experimental class	15.53	2.082	.306	.192	.074
	Control class	16.25	1.687	.246		.073
Perseverance in learning	Experimental class	16.53	2.157	.312	.303	.002
	Control class	15.15	2.031	.297		.002
Teamwork skills	Experimental class	20.93	2.223	.327	.004	.004
	Control class	19.25	3.085	.454		.004
Communication skills	Experimental class	17.59	1.412	.207	.003	.000
	Control class	15.68	2.271	.337		.000

From the results of data analysis in Table 3, it can be seen that in the three dimensions of mastery of core knowledge, teamwork ability and communication ability, the mean and standard deviation of class 7 are higher than that of class 8, and the P-value and Sig of the two classes are less than 0.05, which indicates that a significant difference has been reached. In the dimension of academic perseverance, the mean of class 7 is greater than that of class 8, the P value is greater than 0.05, which satisfies the chi-square, and the value of analyzing Sig is 0.002, which indicates that there is a significant difference. The reason is that the classroom of the control class adopts the way of teacher lectures, and students imitation and practice, and this teaching method ignores the students' main position and does not give students the opportunity to show and communicate, which is not conducive to students' active learning, active participation and communication and sharing, resulting in the failure of students to exercise and improve their communication and cooperation ability and communication ability. The physics teaching system is student-oriented and project-based, guiding students to apply information technology to solve problems. Teachers choose and design themes that are closely related to life, guide students to use collective wisdom to think and solve problems, and provide students with opportunities to display and share, thus effectively enhancing students' mastery of knowledge, improving their ability to apply information technology, and enabling students to improve their teamwork and communication skills in communication and discussion.

4.2 Comparative Analysis of Student Achievement

Learning achievement is a direct and effective way to provide feedback on students' learning effect, which can reflect students' mastery of knowledge learning to a certain extent and can be regarded as a supplement to the cognitive dimension of deep learning. In order to analyze whether the teaching mode of knowledge mastery of students promotes the effect of this section of the physics teaching system for the content of the preparation of the test questions on the two classes of students for the examination, the test questions by the multiple-choice questions, judgmental questions and operational questions composed of three parts of the total score of 100 points. Figure 4 shows a scatter plot of the distribution of student performance in the two classes.

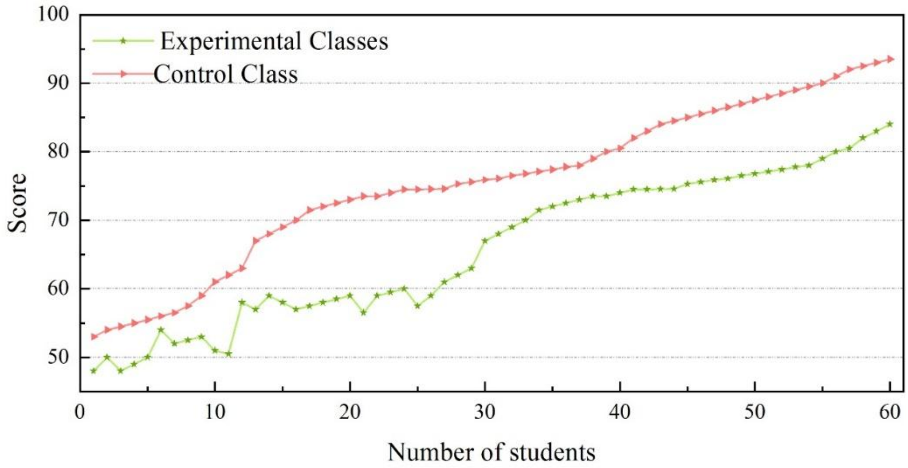

Figure 4 Scatterplot of student performance distribution in two classes

From Figure 4, it can be seen that the performance of the experimental class in this examination is significantly higher than that of the control class as a whole, with smaller fluctuations in performance, which indicates that students in the experimental class have a better mastery of knowledge and skills than that of the control class and that there is a smaller gap in performance between students.

In order to more accurately analyze the difference between the results of the two classes, the results obtained were imported into SPSS to carry out descriptive statistical analysis of the results of the students in the two classes, and Table 4 shows the results of descriptive statistics of the results of the two classes.

Table 4 Statistical analysis of the performance of the experimental class and the control class

Classes	N	Average value	Standard deviation	Mean SE	T	Sig
Class 7	60	75.552	10.459	1.379	2.519	0.012
Class 8	60	65.910	11.748	1.388		

The statistics in Table 4 show that there is a deviation in the means of the two classes, the mean score of class 7 is 75.552, and the mean score of class 8 is 65.910, which is a difference of 9.642 points between the means of the two classes. The Sig of 0.013 is less than 0.05, which indicates that there is a significant difference in the performance of the two classes. These data indicate that the application of the physics teaching system in the physics classroom can improve the status quo of students' learning through mechanical imitation, can enable students to better understand and apply what they have learned in practical inquiry, and enhance their ability to apply information technology. The standard deviation reflects the degree of dispersion of the data, and it can be seen from Table 4 that the standard deviation of class 13 is smaller than that of class 14. This can again show that the physics teaching system can effectively enhance students' learning initiative and thus narrow the gap between students. Overall, after the implementation of the physics teaching system constructed in this study, the student's performance was improved, and the difference in performance between students in the experimental classes was small. This shows that the new teaching mode can help students better master knowledge, improve their ability to use information technology and achieve better teaching results than traditional teaching.

5. Conclusion

This paper starts from the current situation of physics teaching, builds a physics teaching system based on big data background, models the teaching system based on deep learning algorithms, improves the generalization ability of the model by using the attention mechanism, and analyzes the physics classroom teaching of the two seventh-grade classes in Z Middle School as an example, and draws the following conclusions:

(1) In terms of the comparative analysis of deep learning ability, the pre-test and post-test of the two classes were conducted, and from the results of the pre-test, it was learned that there was no significant difference between the two classes in various dimensions, and the deep learning ability was basically comparable to that of the control experiment. From the post-test results, it is learned that in the three dimensions of mastering core knowledge, teamwork ability and communication ability, the mean and standard deviation of class 7 are higher than that of class 8, and the P-value and Sig of the two classes are less than 0.05, which indicates that a significant difference has been reached. Side by side, it shows that the physics teaching system is student-oriented, giving students the opportunity to show and communicate, which is conducive to students' active learning, active participation and communication and sharing so as to improve students' communication and cooperation ability and communication ability.

(2) As far as the comparative analysis of students' performance is concerned, the performance of the experimental class in this examination is significantly higher than that of the control class as a whole, with less fluctuation in performance. There is a deviation in the mean value of the two classes, the average score of class 7 is 75.552, and the average score of class 8 is 65.910, and the difference between the two classes' mean values is 9.642, where the Sig is 0.013 less than 0.05, which indicates that there is a significant difference in the scores of the two classes. These data indicate that the application of the physics teaching system in the physics classroom can improve the learning status quo of students' mechanical imitation, can enable students to better understand and apply what they have learned in practical inquiry, and enhance their ability to apply information technology.

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