Intelligent Evaluation Method of Architecture and Interior Art Design Education Based on LSTM Neural Network

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Abstract. The traditional teaching and evaluation methods lack practicality and cannot meet the needs of students, and it is difficult to convert theoretical knowledge into practical level. The current teaching of the architecture and interior art design CAD suffers from low levels of information technology application and participation by teachers, outdated teaching concepts and a single teaching model, weak practical teaching links that are out of step with industry requirements, and simple and one-sided teaching evaluation methods. In this paper, we propose an intelligent teaching evaluation method based on Short Long-term Memory (LSTM) neural networks for architecture and interior art design CAD. The method combines the characteristics of unstructured text and structured information of teachers' evaluation, after-class assignments and lab reports to integrate entities into the LSTM to build a perceptible entity LSTM neural network, and then combines entity relationships with weights to ensure that the final integrated grade reflects students' comprehensive performance with high reliability, so as to make timely predictions and treatments. Experimental results show that teaching evaluation Method based on LSTM neural network can also help education administrators to carry out information management and performance assessment, promote teachers' professional development and enhance teaching quality and school management capabilities.

Keywords: Intelligent teaching evaluation method; LSTM neural network; Architecture and interior art design CAD
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1 INTRODUCTION

The evaluation of learning of architectural design is the process of evaluating the value of both the "teaching" and "learning" aspects of architectural design courses and their development and changes by the evaluation subject according to modern education and teaching concepts, using

appropriate scientific tools or means, and according to certain standards and index systems. The process of value judgement [1]. The assessment of the teaching and learning of architecture and interior art design CAD is an important guide for students, teachers and educational administrators. For students, it has diagnostic, guidance and motivational functions; for teachers, it has diagnostic, motivational and management functions; for education managers, it has management functions and can be the basis for their scientific decision-making and the formulation of their working guidelines.

The teaching objectives of the architecture and interior art design CAD course are divided into ideological education objectives, knowledge teaching objectives and skills teaching objectives. The ideological education objective is to cultivate students' hands-on ability and project capability through practical design. Form a scientific and rigorous working attitude and patient and meticulous working style. Secondly, through project-based teaching, group practice and other ways to cultivate students' teamwork ability and team spirit. The knowledge teaching objective is to focus on mastering the knowledge of architecture and interior art design CAD such as three-dimensional composition, space limitation and environmental design. To further strengthen the environmental awareness of architectural design and the ability to reasonably divide functional zones according to the nature of different buildings.

The emergence of the architecture and interior art design CAD has certain characteristics of the times, some of the problems of the teaching mode of the architectural design profession have slowly emerged. As a result, many schools have changed the length of study from four years to five years in order to provide more time for students to study. In addition, the design of the curriculum does not form a complete and systematic system, and it is often difficult for students to improve their design level. The architecture and interior art design CAD is to provide society with high-quality architectural design talents, who must have the ability to integrate the social environment and aesthetics and other factors, and whose knowledge structure must be sufficiently complete, and also need to have a strong ability to apply knowledge [2]. In the process of architecture and interior art design CAD education, some universities still have a lot of shortcomings in the design of teaching links, and there are still a lot of problems in the cross-learning of disciplines, and it is often difficult for students to improve their design ability significantly at a later stage, especially for some more complex architectural designs, students often do not have the corresponding ability. Finally, in terms of the learning environment, architecture and interior art design CAD majors need to provide students with better hardware and software facilities, but some schools do not pay attention to this aspect of construction, and students' practical skills are not effectively improved.

Assessing the effectiveness of teaching and learning provides an insight into all aspects of teaching and learning, so that its quality and standard, effectiveness and deficiencies can be judged. In addition to estimating the degree to which students' performance has met the learning objectives, a thorough and objective assessment exercise also identifies the primary causes of subpar performance and explains why it occurred.

Innovative teaching concepts, teaching resource banks, teaching models, and the adoption of diverse teaching and evaluation tools to enable mobile and personalized learning. Traditional learning methods are facing unprecedented challenges, with the boundaries between formal and informal learning increasingly blurred and the rapid spread of online learning, mobile learning and intelligent guided learning, highlighting the personalization of education. Personalized learning has led to a dramatic change in the roles of both teachers and students, with teachers changing from traditional duck-fillers to guides of knowledge. Diversified information technology tools, innovative teaching concepts and teaching models have greatly stimulated students' interest in learning, transforming them from passive to active learners. At present, most of the evaluation of the teaching of architecture and interior art design CAD is done by the teacher alone, and is not good at using information technology to collect evaluation data, the main basis of evaluation is based on the students' usual performance, homework results and final exam results. However, many designs in architectural design courses require students to work in groups, and teachers may not

always be able to grasp the actual design level and participation of each student in the group, so it may be biased and unfair for teachers to assess the performance of each student alone. In addition, there is uncertainty as to whether the teacher's personal assessment perspective and level is in line with that of the corporate sector [3].

In the previous assessment method, teachers subjectively assessed and analyzed students to assess the quality of the teaching of CAD courses in architecture and interior art design. However, this method lacks objectivity and can not be used as a general quality evaluation method in the intelligent teaching evaluation of architecture and interior art design CAD course. In this regard, this paper proposes to propose an intelligent teaching assessment method based on Short Long-term Memory (LSTM) neural network for architecture and interior art design CAD majors. The method combines the unstructured text and structured information of teachers' evaluation, after-class assignments and lab reports to integrate entities into the LSTM to build a perceptible entity LSTM neural network, and then combines entity relationships with weights to ensure that the final integrated score can reflect students' comprehensive performance with high reliability, so as to make timely predictions and treatments, help speed up teaching progress, reduce teachers' burden and promote students' personality development; it can also help education administrators to carry out information management and performance assessment, promote teachers' professional development and enhance teaching quality and school management capabilities.

2 RELATED WORKS

To construct an online learning system, Sun et al. [4] integrated artificial intelligence modules and knowledge recommendation into the teaching system. Examining potential internal links between evaluation outcomes and various variables is a beneficial use of intelligent teaching approaches. Also, they help teachers become more effective in their instruction so that they can adapt to each student's personality and level of academic proficiency. He et al. [5] combined BP neural network with fuzzy mathematics theory to establish an evaluation model for scientific research talents in universities. Based on the talent training process and ability requirements of colleges and universities, a two-level index system is proposed, and the weight of evaluation index is determined by data collection.

Lin's study [6] provided a brief overview of the history and current state of teaching evaluation, as well as the fundamentals of pertinent algorithms for data analysis and modeling using data mining and machine learning techniques. This helps to promote the intelligent development of teaching evaluation. The findings demonstrate that the study model's scores are comparable to those obtained using a standard manual, which can serve as a theoretical benchmark for other investigations in the same area. A strategy for assessing the impact of the intelligent teaching mode on classroom instruction was put forth by Chen and Lu [7]. The experimental findings demonstrate that the suggested method can successfully increase the accuracy of the intelligent teaching mode's classroom teaching effect evaluation while also offering a fresh approach. Traditional mobile smart teaching assessment methods are time-consuming and prone to computational errors because they use unclear teaching tasks and overlook the labeling of crucial physical education tasks. De-kun and Memon [8] created a novel mobile intelligent assessment algorithm as a result, and they used it to evaluate mobile intelligent physical education teaching. The sequential intelligent annotation of physical education activities was carried out by a mobile intelligent bi-directional LSTM model. The weights of assessment indicators were established, and a quantitative evaluation model was developed, in accordance with the influencing variables of intelligent management of physical education resources.

3 MODELING METHODS AND INTELLIGENT TEACHING AND LEARNING ASSESSMENT METHODS

3.1 LSTM Neural Network Introduction

The LSTM is a special kind of recurrent neural network (RNN) and is the more popular current implementation of RNN networks. The benefits of using this structure are also very obvious: if in the time series, the previous content has an influence on this input, then the relationship of this influence can be learned. For such relationships over time series, traditional feed-forward and convolutional neural networks are not applicable [9]. The LSTM network is implemented using a recurrent layer, which has the feature of taking the previous (temporally) input, or the excitation values therein, together with the current one, as the input to the network. the structure of the LSTM network is more complex, as shown in Figure 1.

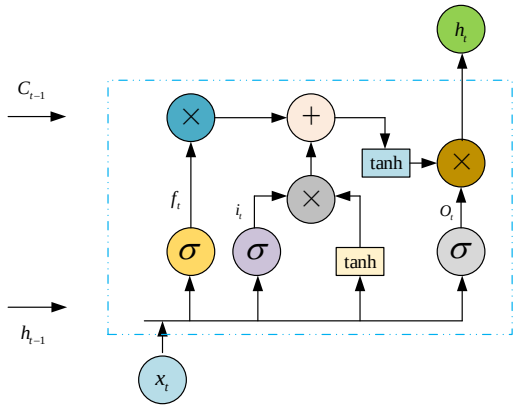

Figure 1: Schematic diagram of LSTM neural network structure.

An LSTM network usually consists of one or two layers of LSTM units, where the units in each layer can be connected at the beginning and end, and the inputs can be passed backwards in time series. For a sequence of inputs X_i, the value of X may affect the output of h_j, which is farther away in time or space, and the process of training is to 'learn' the quantization relationship. In the same layer, the output of the previous unit is fed into the next unit, while the output of the previous layer is used as input to the next layer, similar to a 'black box'. In the LSTM, there are three gate-based computer mechanisms, namely the forgetting gate, the input gate and the output gate [10].

Forgetting gates: The model needs to forget the previous data when new data is entered, and this is accomplished by using forgetting gates. A crucial part of the LSTM unit, the forgetting gate regulates what data is retained and what is forgotten while also preventing gradient disappearance and explosion issues that can occur when gradients are propagated backwards in time. The forgetting gate determines what information the LSTM discards from the previous moment's state, which is then mapped by sigmoid to a value between 0 and 1. Ultimately this value is then multiplied by the current state to determine what information to discard from the input data. When the value is 1 it means that the information in the input data is completely retained, when the value is 0 it means that the information in the input data is completely discarded.

Input gates: Find out which new data is saved in the cell state. Input gates are used to regulate how much of the network's current input data flows into the memory cell, or how much of the input data can be saved to the image. The input gate consists of two parts, the first part: an "input gate" consisting of a sigmoid that generates a control signal between 0 and 1 to control the

level of data input; the second part: a tanh layer that generates candidate data for the current moment, a value that will be used by the data to determine the level of addition to the state. [11]

Output gate: The output value is based on the current state, but there is a filtering process. The first part is a control signal between 0 and 1 generated by the sigmoid "output gate", and the second part is the multiplication of the final output information with the control signal information to obtain the final output value. The output gate controls the effect of the memory unit on the current output data, i.e. which part of the memory unit will be output at time stept.

These three gate-based computer mechanisms can be defined by the equation:

$$f_t = \sigma(W_f[h_{t-1}, x_t] + b_f) \tag{3.1}$$

$$i_t = \sigma(W_i[h_{t-1}, x_t] + b_i) \tag{3.2}$$

$$\tilde{C}_t = \tanh(W_C[h_{t-1}, x_t] + b_C) \tag{3.3}$$

$$C_t = f_t \cdot C_{t-1} + i_t \odot \tilde{C}_t \tag{3.4}$$

$$o_t = \sigma(W_o[h_{t-1}, x_t] + b_o) \tag{3.5}$$

$$h_t = o_t \odot \tanh(C_t) \tag{3.6}$$

i_t , f_t and o_t denote the input gate, forget gate, and output gate. x_t represents a one-dimensional vector or scalar, and h_t can be given a different dimension. The weighted parameter metrices are W_f, W_i, W_C, W_o , which conduct a linear transformation between the vectors. b_i, b_f, b_C, b_o are the intercept parameters. The operator $\odot$ is the Hadamard product.

3.2 Intelligent Teaching Evaluation Method for Architecture and Interior Art Design CAD Based on LSTM

This paper suggests an intelligent teaching strategy based on LSTM for architecture and interior art design CAD that includes the following steps in order to address the aforementioned technical issues:

Data pre-processing: collecting and organizing teacher evaluation data, student after-class homework data, student lab report data and student subject grade data, and grouping and numbering different types of data in teacher evaluation data, student after-class homework data and student lab report data.

Qualitative and quantitative evaluation and analysis: The entities extracted from the previous step, such as teacher evaluation, student after-school assignment and student lab report, were put into the LSTM neural network to extract the corresponding teacher evaluation entity relationships, student after-school assignment entity relationships and student lab report entity relationships.

The relationship weights are evaluated: all the entity relationships extracted in the previous step are integrated in a multi-perceptron; weights are added to each entity relationship in the multi-perceptron and normalized to the corresponding weight analysis score.

Integration of weights: the student's subject results are normalized and integrated with the weight analysis scores obtained in the above steps to obtain the student's overall score.

The above input layer is used to read the entity features of the data, the implicit layer is used to extract the features of the read entities and finally the category with the highest probability value is selected as the result of the model classification, and the output layer is used to output the extracted teacher evaluation entity relations, student after-school assignment entity relations and student lab report entity relations. Further, in the above step, the following six weighting formulas are used to add weights to each student after-school assignment entity relationship:

$$w(i,j)=\frac{n(i,j)}{\sum_{N} n(N,j)} \tag{3.7}$$

where $n(i,j)$ denotes the number of times entity i and correct answer j occur together, $i=1,\ldots,N$.

$$w(i,j)=n(i,j)\times(\log\frac{|D|}{n_i}+1) \tag{3.8}$$

where n_i denotes the number of entities i in a given data sample that contain the correct answer.

$$w(i,j)=\frac{n(i,j)\times\log\frac{|D|}{n_i}}{\sqrt{\sum_{N}(n(N,j)\times\log\frac{|D|}{n_i})^2}} \tag{3.9}$$

$$w(i,j)=n(i,j)\times(\log\frac{\sum_{N} t_N}{t_i})^2 \tag{3.10}$$

where t_i denotes the number of occurrences of entity i throughout the training.

$$w(i,j)=\frac{M\times(X\times Y-Z\times H)^2}{(X+Y)\times(Z+H)\times(X+Z)\times(Y+H)} \tag{3.11}$$

where M, X, Y, Z, and H represent the total number of documents, documents containing entity i and belonging to the correct answer j, documents containing i but not belonging to j, documents belonging to j but not containing i and documents lacking i but not belonging to j.

$$w(i,j)\approx\log\frac{N\times X}{(Y+X)\times(Z+H)} \tag{3.12}$$

For the teacher evaluation entity relationship and the student lab report entity relationship, weights are added using the same weighting formulae as for the student post-class assignment entity relationship. Finally, the average of the weight values obtained from the six weight formulas is used as the corresponding weight analysis score by default before being entered into the fully connected layer. Of course, other implementations may use other reasonable values to obtain the weight analysis score. After normalization of the student's subject scores, they are integrated with the weight analysis scores obtained in the above steps to obtain the student's overall score. In this paper, the normalization process means that subject scores are normalized to the synthetic assessment and analysis content, so that the synthetic student composite scores are unified between [0,100] and 75% of the synthetic assessment and analysis sample is used for training and 25% for testing. Figure 2 depicts the flow chart of the LSTM-based intelligent teaching and learning assessment method for architecture and interior art design CAD.

4 DISCUSSION AND ANALYSIS OF RESULTS

Universities need to provide the market with better professionals in architecture and interior art design CAD, and they need to enrich their teaching methods to improve the overall quality and skills of their students. We use the data from a university's teaching assessment as an example for our experiments. The data is first pre-processed to illustrate the smoothness of the data through the frequency response curve of the filter. When using band-pass filtering, signals in one frequency band are allowed through while those in other frequency bands are blocked. A digital band-pass filter is a band-pass filtering process implemented in software, which can overcome the disadvantages of analogue filters very well. With the increasing maturity of the magnetic method

frequency domain inversion calculation method, the data processed by the frequency domain band-pass filter calculation method can well reflect the characteristics of the field due to the difference in physical properties at different depths in the subsurface, and it is this property of band-pass filtering that is used for the regional field separation of the magnetic field. Figure 3 depicts the tectonic bands reflected by bandpass filtering as a starting point, further illustrating the high stability and realism of the data.

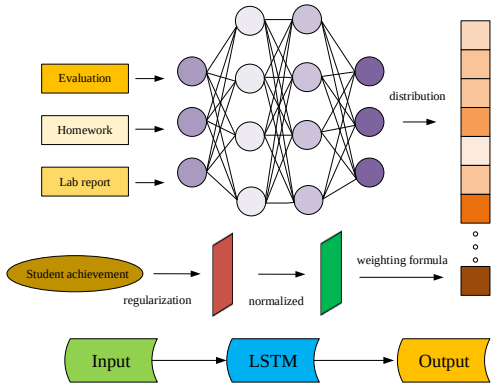

Figure 2: A teaching evaluation method for architecture and interior art design CAD based on LSTM.

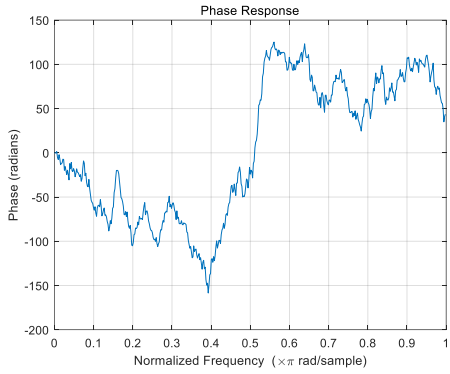

Figure 3: Filter regularization frequency schematic.

Because of the large number of course contents in the architecture and interior art design CAD, students may face some difficulties in the process of practice. In order to solve these problems, universities can innovate their teaching methods and use task-driven to motivate students to take the initiative and actively engage in the practical sessions. To further illustrate the reliability of the data types, a simple spectral analysis of the data is carried out. It is decomposed into a straightforward Fourier transform and a sum of several sinusoidal signals. Each sinusoidal component has its own frequency and amplitude. In order to create the amplitude-frequency distribution of the signals, the amplitude of many of the aforementioned sinusoidal signals were painted on their corresponding frequencies using the frequency value as the horizontal axis and the amplitude value as the vertical axis. The spectrum of the data in this paper is shown in Figure 4, further illustrating the diversity of data types to meet the requirements of the experiment.

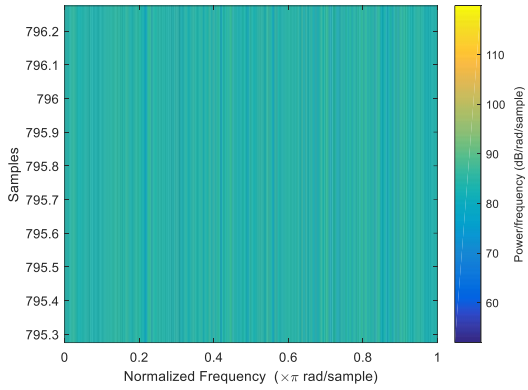

Figure 4: Spectrum estimation chart.

Finally, the link of teaching should make more use of modern education technology to make the teaching process more intuitive, to help students in the learning process can be more easily learn theoretical knowledge, and improve their own practical skills, so that the teaching process of architecture and interior art design CAD is more infectious, so that students have a broader creative thinking. The university should combine its own characteristics to form distinctive schooling features, and develop the architecture profession as the basis to drive the further development of related professions. In addition to ensuring the foundation of the architecture profession, it is also important to make the architecture profession more humanistic and to realize the integration with other professions. Figure 5 shows the effect of the parametric model, paving the way for the accuracy of the experimental results and illustrating the credibility of the model and the stability of the training process.

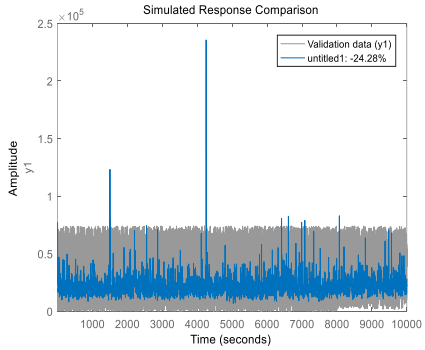

Figure 5: Schematic diagram of parameterized model.

We randomly selected a teacher's teaching assessment results in ten evaluation indicators, the scoring situation of each indicator is shown in Figure 6, it is obvious from the figure that the scoring situation of question 2 and question 3 is obviously lower than other indicators, indicating that the teacher in these two evaluation indicators, do not do enough, and found that these samples do have some teaching problems. After a variety of trials, manual comparisons, and analyses, it was discovered that the intelligent teaching assessment approach based on LSTM for architecture and interior art design CAD in this article is more in line with reality, further demonstrating the paper's usefulness and intelligence.

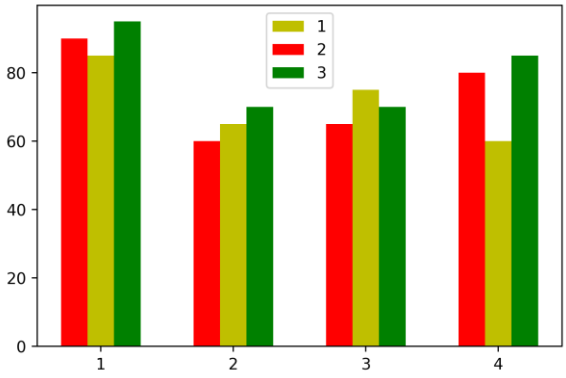

Figure 6: Scores of each indicator.

The teaching assessment should be carried out with a focus on the practical process of the students, and through the planning and renovation of old sites to accumulate a wealth of practical experience for students. Students' innovation in research and theoretical and practical learning have a very important role to play and are an important development path for the training of high quality architecture and interior art design CAD, while also focusing on innovation in the form of teaching and learning so that students have a more complete and innovative mind and further improve their innovative abilities.

In machine learning, loss functions are very important for measuring how good the target outcome is and for training model stability evaluation. In this paper, we further visualize the training effect of 50 batches and 100 batches. Figure 7 shows the training state of the model for 50 batches, which shows that the model has good convergence overall, converging to the most additive state at a relatively fast rate. Figure 8 shows the training effect of 100 batches, the model has good overall convergence and the overall fluctuation of the training process is not significant, which indirectly illustrates the effectiveness of the model in this paper and can be used for intelligent teaching evaluation in architecture and interior art design CAD.

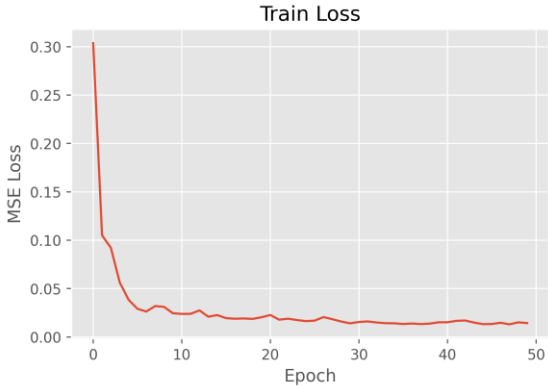

Figure 7: Loss of training in 50 batches.

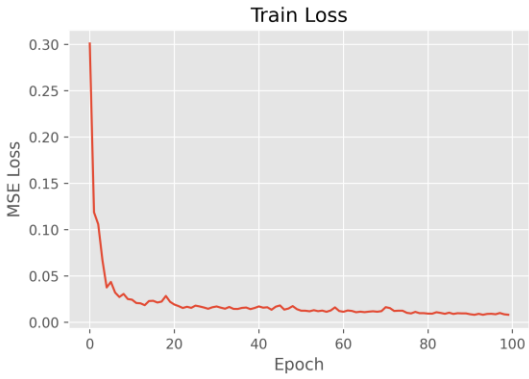

Figure 8: Loss of training in 100 batches.

5 CONCLUSIONS

Intelligent teaching assessment in architectural design is an important part of the teaching process, which is related to the teacher's teaching motivation and the students' learning initiative. At present, the traditional assessment work of combining attendance with examinations in the teaching practice of information literacy in colleges and universities has been difficult to break through and innovate, and relevant studies also lack systematic analysis of assessment methods. This paper proposes an intelligent teaching assessment method for architecture and interior art design CAD, hoping to draw relevant conclusions for teachers, students and educational administrators to refer to when choosing assessment methods, so as to raise the standard of information literacy instruction given to university students.

The above analysis shows that the intelligent teaching evaluation method of architecture and interior art design CAD course teaching based on LSTM neural network is helpful to accelerate the teaching process and promote the personal development of students. The new intelligent assessment method can help educational administrators to carry out information management and performance assessment, promote the professional development of teachers, further improve the teaching and learning effect of courses, and improve the efficiency of personnel training.

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