Design and Application of Preschool Education System Based on Mobile Application

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With the rapid development of information technology in recent years, the country’s information reform in the field of education is advancing gradually. As the first link in the chain of lifelong education, the development of early childhood education informatization has become an essential component of the national education informatization construction. In order to better realize the gamification of early childhood education courses and strengthen the management and deepening of course resources, this paper analyzes the significance of the application of children’s games in teaching and the significance of the application of new media resources in children’s course games by combining the actual situation of education and the teaching advantages of new media resources. The paper studies the application of early childhood education teaching and the research on the development of gamification in early childhood education courses. In light of the fact that emerging preschool education products on the market cannot fully meet the requirements of preschool education informatization construction at the level of function and technology, this paper proposes a preschool education system based on mobile applications as well as a child-appropriate recommendation algorithm based on a multiattention mechanism. Experiments conducted on public data sets demonstrate that our algorithm is considerably superior to the benchmark algorithm.

1. Introduction

As a result of the rapid expansion of modern information technology, the country’s information technology reform in the education sector is advancing slowly but steadily. The improvement of the informatization level of preschool education, which serves as the first link in the chain of lifelong education, is correlated with the quality of teaching and the rate of development of today’s preschool education, and it has emerged as a crucial element in the construction of national education informatization. The cloud platform has characteristics such as accessibility, security, and integration [1–6]. The system uses broadband technology, mobile Internet technology, cloud computing technology, integrates resource advantages, scientifically and rationally builds a cloud platform for early childhood education, standardizes management, improves quality, and completes the second phase of the project. The success of the five-year action plan for preschool education and the acceleration of the education information technology integration process are crucial [7, 8].

The gamification of early childhood education courses is a development trend in early childhood education that is currently recognized internationally, and it is also a new direction for the development of early childhood education in my country. In modern education, the gamification of early childhood education courses is a development trend in early childhood education that is currently recognized internationally [9, 10].

Children can acquire the richest social experience possible in the process of learning through the use of new media resources in the gamification of children’s courses. This has a significant impact on the development of children’s growth, love, and sense of responsibility. Teachers should make full use of the resources that new media can provide, as well as network teaching resources, in order to better realize the gamification of the preschool education curriculum. They should then analyze and
integrate these resources in order to design the most beneficial gamification curriculum for children’s growth. It examines how to use multifaceted and multilevel educational materials in the gamification of preschool education courses, with a particular emphasis on how to approach the issue from the standpoint of new media.

The official debut of the national basic education cloud platform, which was constructed on the foundation of the national basic education resource network, took place in 2013. Although the early childhood education market has experienced a tremendous expansion in recent years, particularly after the implementation of the two-child policy, it is expected to continue to grow at a high pace in the coming years [11, 12]. At the same time, kindergartens have a tough time obtaining high-quality multimedia education resources, which makes it difficult to enrich classroom activities and teaching in general. Professional development and training opportunities for preschool teachers are limited, and the overall quality of the team is inconsistent. They are particularly sensitive to new changes, especially when it comes to the communication link at home. Modern parents, particularly those born in the 1980s and 1990s, are keen to improve communication at home through modern information technology, engage in their children’s education, and actualize collaborative education in the home. With the shift of early childhood education away from traditional administration and teaching and toward informatization, the development of the early childhood education sector has become an unavoidable trend in recent years. The development of preschool informatization products that are based on the preschool education cloud platform occurred in this context [13–16].

While the national basic education cloud platform, which is driven by national forces, has been developing, the market product has been more reflective of the development of the preschool education cloud platform than of the national basic education cloud platform. It serves a single purpose, is primarily market-oriented, and is solely motivated by profit. Among other things, there is less effective public service information, less transparency, less sharing of information resources, an inadequate supply of effective resources, public service functions have not been accurately reflected, and service quality must be improved [17–21].

Traditional recommendation models are unable to learn deeper feature interaction behaviors and improve the accuracy of recommendation models as a result of a large amount of data available [22–24]. This is due to limitations such as insufficient feature cross-capacity, a limited ability to learn high-level features, and the need for manual feature engineering. Deep learning models have begun to gain popularity in the fields of recommendation systems and computational advertising as a means of extracting more feature information from large amounts of data. Some researchers have combined the characteristics of linear models and nonlinear models by using multisource heterogeneous data, such as user characteristics, context characteristics, and item characteristics, and proposed the Wide&Deep model, which has been applied to mobile APP recommendation and is described below [25–30]. The Deep part’s function is to ensure that the model has a high degree of generalization capacity by enhancing its memory ability. Other researchers modified the Wide&Deep model by substituting FM for the Wide component, and they suggested the DeepFM model, which included additional low-level feature interaction learning. Another AFM model that some researchers proposed was based on adding an attention network between the feature intersection layer and the output layer and updating the weights through this attention network in order to determine the degree of influence of different feature intersections on the recommendation results [31–36].

This study presents a multiattention mechanism and a multi-AFM model, both of which are founded on FM and AFM. This article also applies the multi-AFM model to the early childhood education system, recommending the enrollment of adequate numbers of children in age-appropriate courses.

2. Background

2.1. An Overview of Early Childhood Education

Informatization. Informatization of preschool education is the use of computer and network technology to increase efficiency in the field of preschool education. This includes the informatization of educational management, education, and teaching as well as home interaction in the field of preschool education. It is not only the strategic direction of the country’s education modernization but also a strict requirement for the administration and instruction of preschools on a daily basis. Preschool education informatization can be divided into the following categories based on the nature of the underlying product or service.

The transition from a single textbook-based teaching method to a digital and intelligent content-carrying method, combined with big data analysis, artificial intelligence, and other technologies, increases the efficiency with which teachers prepare courses and maximizes student learning outcomes.

Second, the use of multimedia in the classroom has the potential to organically organize a variety of media, including text, images, sound animation, and other forms of dynamic and engaging audiovisual content, thereby increasing children’s interest in learning and enhancing their language expression, imaginative thinking, and aesthetic awareness. Currently, augmented reality and virtual reality technologies are being implemented in preschool education, which will enhance classroom instruction.

Thirdly, by utilizing modern information technology, the principal and teachers can abandon the traditional and time-consuming management of student status, fees, office administration, attendance, and other aspects of kindergarten administration, thereby significantly enhancing the kindergarten administration’s overall efficiency.

In addition, monitoring devices allow teachers, parks, and parents to track the whereabouts of students, thereby enhancing the overall safety and security of the student body.

Lastly, it addresses the issue of real-time communication between teachers and parents and establishes a connection...
between kindergarten education and family education by leveraging the benefits of mobile Internet.

2.2. Problems Existing in the Application of Early Childhood Education. Many preschool education informatization products are currently available on the market, with the majority of them primarily delivering services to preschool user groups in the form of home coeducation platforms. The following are the most common issues that arise with this type of product:

(1) The product’s core technology is the aging process. Many technical problems, such as automatic data collection and cross-system data synchronization of many products, have not been resolved, and a large amount of data must be entered manually, resulting in a significant increase in the workload of teachers and inaccurate data verification in the system.

(2) There is significant product homogeneity as well as a low level of information technology integration. Today, 90 percent of products only provide the two fundamental functions of family engagement and attendance or a few features that are only superficially useful and have not made a significant difference in the information management and operation of kindergartens.

(3) The product does not have the capability of mining large amounts of data. When it comes to information technology, many products are used primarily for the transmission of messages and pictures, with little data and no in-depth analysis or mining of data, making it impossible to find problems through data mining and having no practical impact on kindergarten management or child-rearing.

(4) The system’s ability to provide information security assurance is limited. At the moment, the majority of these products lack high-level information security protection capabilities as well as data disaster recovery capabilities, and there is a risk of leakage and loss of sensitive information, such as children’s identification information and educational data.

In addition, the regional preschool informatization management platform provided by the education authority and other departments is largely empty. To address the aforementioned problems, on the one hand, the Hebao preschool education cloud platform has been developed, which integrates the advantages of network resources and uses broadband technology, communication technology, information security technology, and cloud computing processing technology comprehensively, providing parents, kindergarten teachers, and principals with home interactive coeducation, high-quality parenting teaching, and one-stop preschool education. The infant preschool informatization platform, on the other hand, is being developed to provide provincial and municipal education authorities with a uniform preschool informatization service platform.

2.3. The Application Method of New Media Resources in the Gamification Teaching of Early Childhood Courses. Teaching methods and educational concepts for children are continually being reformed and updated as a result of the ongoing growth of new media, while old teaching methods have failed to keep pace with the evolution of the times.

As a result, in order to meet the demands of modern teaching, we must investigate new education and teaching models that are appropriate for the times; make full use of new media resources; implement happy, efficient, and scientific teaching methods through modern education and teaching models that are appropriate for the times; incorporate the use of modern media resources into the gamification of children’s courses in an active manner; create a comfortable and joyful learning environment for children; and allow children to learn in happiness while growing in health.

2.3.1. Maximize the Usage of Family Resources by Utilizing Big Data. For every youngster, the family is the most trustworthy institution in society. As the child’s first teacher, the parent’s personal work, interests, and social experience all have a subtle impact on the child’s outlook on life and development. To this end, the use of family resources in preschool education courses is a crucial component of the game-based learning approach. To effectively integrate planning and usage of family resources, big data must be used in a reasonable manner. This is especially true in the case of gamification in the teaching of preschool education courses.

Kindergartens will be better able to integrate and plan family information in this manner as well as actively create positive relationships with parents. They ask parents if they are able to combine their careers and hobbies in order to participate in parent-child participation in kindergartens, with the underlying assumption that parents’ time is completely respected. Assistant game lessons and exercises are taught to students. While doing so, the kindergarten can record the entire process as vlog using the short video mode and then record the child’s growth step by step, which can not only improve the participation of parents in the gamification course but also assist the children in gaining social development and making better use of family resources as well.

2.3.2. Optimal Use of Social Resources through Information Technology. The use of information technology is becoming increasingly significant in the modern era. As a result of the rapid growth of information technology, the means of information education have also been fully integrated into today’s preschool education system and have progressively emerged as an integral means of instruction in the contemporary preschool education system.

The continuous deepening and utilization of information resources and information technology not only provides convenience for preschool education in orienting functions, writing syllabuses, designing curriculum plans, and controlling the teaching process but also provides
4 Mathematical Problems in Engineering

Numerical problems and evaluating functions. Using the incentive function, teachers and students can improve the quality of their instruction and learning, and this can serve as an internal driving force for the development of gamification teaching activities. Using the evaluation function, teachers and students can obtain an accurate reference standard for the benefits and drawbacks of gamification teaching effect.

In the modern media environment, a rich network resource pool can be developed in the preschool education system, which can afterwards be used for other purposes. Teachers in the park can make full use of modern information teaching methods, select a variety of high-quality resources that can serve education in big data, and create gamification courses that are appropriate for children's learning with the combined efforts of all teachers in the park in the development of preschool education gamification course teaching. Meanwhile, it may take into consideration each child's unique developmental stage and create a one-of-a-kind curriculum of games and activities.

2.3.3. Utilize Living Resources through the Characteristics of the Times. The society is continually evolving, the times are constantly progressing, and high-tech is progressing at an exponential rate. The education industry has been particularly affected by new technologies, which have provided a significant boost to the development and advancement of education, as well as the updating of teaching methods and educational concepts, which has resulted in education becoming more mainstream and in keeping with the times.

Throughout history, education has bolstered people's confidence and led them down a path of educational advancement characterized by Chinese characteristics in the new millennium. The purpose of education has been accomplished, as it has fostered newcomers to the era who have been entrusted with significant responsibilities at a young age. Education has established goals and cultivates exceptional qualities through the all-encompassing development of morality, intelligence, physicality, attractiveness, and diligence. Beginning with the most fundamental aspects of education and progressing step by step toward the realization of socialism's modernized educational power, educational innovation has produced scientific and technological advancement.

In addition to the typical educational activities, students can take the initiative to pay attention to life, observe diverse situations on their commute to and from school, and then record their commute in order to study these lives collectively.

In order to accomplish this, the park can incorporate the network map into the teaching activities so that the children can learn where the park is located while also learning about the community in which their home is located, mark the locations on your home route that have left an effect or piqued your attention, and make sure to label them clearly.

We can cultivate children's safety awareness through gamification activities, help them get more familiar with their own living environment, and help them reach their independence as soon as possible through these activities.

Not only that, but when children learn about the living arrangements in the vicinity of the park, they are more likely to use them.

In conclusion, teachers should identify the focus of children's attention through analysis and study and then construct the "My city is incredibly beautiful" teaching game handbook. Using the incentive function, teachers and students can improve the quality of their instruction and learning, and this can serve as an internal driving force for the development of gamification teaching activities. Using the evaluation function, teachers and students can obtain an accurate reference standard for the benefits and drawbacks of gamification teaching effect.

3. System Design

3.1. Architecture of Function. The preschool education platform employs three APP clients: parents, teachers, and principals, as well as the kindergarten's web platform, to perform the following functions.

3.1.1. Terminal for the Parent. Home interaction, traditional parenting, infant growth, safety morning inspection, and video surveillance are the five sections of the parent-side material.

(1) Interaction within the Home: it primarily serves four purposes: class circle, behavior logs, family activities, and attendance and leave.

(2) Traditional Child Rearing: collect high-quality parenting resources both at home and abroad, including a huge number of children's books, picture books, songs, and other forms. Support parents in subscribing to information of interest, as well as intelligent recommendation from the system, which can help parents get personalized parenting knowledge fast.

(3) Baby Growth: assist instructors and parents in completing the baby growth story together and choose a template to make an electronic version of the growth file with only one click. To help parents enhance their parenting abilities, well-known preschool education professionals answer queries online.

(4) Morning Safety Inspection: the intelligent attendance system captures data on children entering and leaving the kindergarten as well as pick-up and drop-off photographs, which parents may examine in real time. Body temperature checks in the morning and afternoon, as well as prompt prevention of common diseases, are all part of the kindergarten's health program.

(5) Video Surveillance: parents can monitor their children's activities and learning in the kindergarten at any time using their mobile phones, allowing them to feel more at peace.
3.1.2. From the Viewpoint of the Instructor. The teacher side increases teacher–parent contact, decreases teacher workload, and better realizes home education; at the same time, it offers instructors with rich teaching resources and transforms into an intelligent teaching assistant in their hands. Highlights:

1. Keep a Behavior Log: create a method for evaluating a child’s progress based on five categories: ability, habit, character, health, and improvement. Support unique behavior labels, collect the baby’s daily growth data, and provide quick feedback to parents.

2. Family Activities: teachers promote parent-child educational and childcare activities, create a link between kindergarten and family childcare, and implement homeschooling.

3. Instructional Materials: to assist teachers in improving themselves step by step, provide teaching materials such as famous garden teachers, teaching guidance, teacher training, expert courses, fascinating activities, learning applications, and other teaching materials.

3.1.3. The Garden Manager’s and Garden Management’s Web Platform. Provide garden management, garden user administration, garden statistics, and other features in the form of a mobile phone client and a Web terminal, making it easy for the garden manager to carry out the necessary tasks.

1. Kindergarten Statistics: supports statistics, data viewing, and report export for functions such as children’s attendance, teacher activity, parent activity, behavior records, and communication records. The park can provide statistical data on a daily, weekly, monthly, or custom basis.

2. Review Management: assist the park’s managers in reviewing and controlling the content uploaded and released by various operators, controlling public opinion, and improving the quality of the content produced.

3. Data Processing in the Park: add, delete, and amend basic information on faculty, staff, and students.

4. Class Album: synchronize the images taken during special times in the teacher’s and parents’ classrooms. Teachers’ photos are shown in the style of a timeline. Parents’ photos are stored in albums named after their children.

3.2. Multi-AFM. The expression of FM is as follows:

\[
\hat{y}(x) = w_0 \sum_{i=1}^{n} w_i x_i + \sum_{i=1}^{n} \sum_{j=i+1}^{n} \langle v_i, v_j \rangle x_i x_j,
\]

where \( n \) represents the number of features of the sample, \( w_0 \) represents the bias of the constant term, \( \langle v_i, v_j \rangle \) represents the inner product operation of the vector, and its algorithm is shown in the following formula:

\[
\langle v_i, v_j \rangle = \sum_{p=1}^{k} v_{i,p} \cdot v_{j,p}. \tag{2}
\]

Even in the absence of interaction data, the FM model permits the inner product method calculation of similarity between two features.

The AFM model adds an attention network between the feature intersection layer and the final output layer in order to weight the intersection features and discern the varied effects of different intersection features on the outputs. Its attention network learns the weights of the second-order feature intersection using a neural network with a single hidden layer, then uses weighted summation to produce the final output. The following is a mathematical representation of a portion of the attention network:

\[
a'_{ij} = h^T Q(W(v_i \odot v_j)x_i x_j + b),
\]

\[
a_{ij} = \frac{\exp(a'_{ij})}{\sum_{i} \exp(a'_{ij})}, \tag{3}
\]

where \( Q \) represents the RELU function, \( a'_{ij} \) represents the attention score of the feature combination, and \( a_{ij} \) represents the attention weight of the feature combination.

Cross-attention is as follows:

\[
\sum_{i=1}^{n} \sum_{j=i+1}^{n} a_{ij}(v_i \odot v_j)x_i x_j. \tag{4}
\]

The multihead self-attention mechanism is one of the attention mechanisms in which each head uses the same calculation method but has distinct parameters, allowing feature representation to be performed from several subspaces. It can get features in several dimensions as opposed to the typical self-attentive technique. The multihead self-attention mechanism performs only one computation during computation and then merges the results. The scaled dot product attention operation is used to implement the multihead self-attention mechanism, and its output is

\[
L(G, K, V) = \sigma \left( \frac{G K^T}{\sqrt{d_k}} \right) V, \tag{5}
\]

where \( \sqrt{d_k} \) represents the dimension of the \( K \).

The AFM model has a few flaws. This paper proposes multi-AFM, a combination of the AFM model and the multihead self-attention mechanism, to circumvent these limitations.

The features input by the model for the recommendation system task fall into two categories: continuous features (such as user age and statistical features) and category features (such as the category of the recommendation system work) (such as user gender and item attribute labels). It is essential to map continuous features and categorical features into the same low-dimensional feature space in order to enable feature intersection between continuous and categorical features.

As for continuous features, the low-dimensional embedding space is immediately mapped to the continuous feature space, and each continuous feature corresponds to a
feature vector in the low-dimensional embedding space. It is important to employ one-hot encoding to convert categorical characteristics into numerical vectors in order to process them into numerical vectors. The following is the outcome of one-hot encoding as shown in Figure 1.

Following their passage through the embedding layer, the input features are transformed into dense feature vectors for further analysis. The following is the mathematical expression for it:

\[ a^{(0)} = [e_1, e_2, \ldots, e_m]. \]  \hspace{1cm} (6)

The dense vector output of the embedding layer is initially fed to the AFM, which produces the first-order linear feature vector and second-order feature cross-vector. The second-order feature cross-vector is then fed to the attention network, which produces the second-order feature cross-vector for each second-order feature cross-vector. As a result of multiplying the attention weight by the second-order intersection and vector, the summation and pooling operation is performed. At the conclusion of the procedure, the first-order linear feature vector of FM is added and concatenated to produce the AFM output. The following is its organizational structure: Figure 2 depicts a cross-vector of second order, a vector weight, and a dot product. The dark portion of the diagram represents the second-order cross-vector, while the lighter portion represents the vector weight, and the dashed line represents the dot product.

Then, we have

\[ \overline{y}_{afm} = w_0 + \sum_{i=1}^{n} w_i x_i + p^T \sum_{i=1}^{n} \sum_{j=i+1}^{n} a_{ij} (v_i \odot v_j) x_i x_j. \]  \hspace{1cm} (7)

The propagation process of the Deep part is as follows:

\[ a^{(l+1)} = \sigma(W^{(l)} a^{(l)} + b^{(l)}), \]

\[ \overline{y}_{1} = \sigma(W^{(h+1)} a^{(h)} + b^{(h+1)}). \]  \hspace{1cm} (8)

4. Results

It was carried out using the publicly accessible data sets: Criteo data set and MovieLens-100k data set.

The Criteo data set must be preprocessed before it can be utilized due to the large number of missing values discovered through data analysis. As seen in this experiment, when categorical features have missing values, the missing values of continuous features are filled with zero, and normalization is performed on all continuous features to normalize them to the [0, 1] interval. Both data sets are divided into three groups: the training set, the validation set, and the test set, in that order.

The accuracy (P), the area under the curve (AUC), and the root mean squared error (RMSE) are the evaluation indicators that were utilized in this study. FM, AFM, DFM, and NFM are the comparison algorithms that are used in this paper. The results of contrasting various methods with regard to two distinct data sets are shown, respectively, in Figures 3 and 4. On a variety of data sets, it has been demonstrated that the performance of the multi-AFM algorithm is superior to that of the comparison algorithm in terms of all three performance indicators.

This study analyzes the outcomes of ablation experiments in which the input size of the multihead self-attention mechanism was changed to determine the optimum value for the input size. The purpose of this research is to
determine the optimal value for the input size. The results of the experiments are shown below in Figure 5, which can be found here.

Because it can be shown in Figure 5 that the model’s evaluation indicators perform better on the data set when the input size is 12 than when the input size is any other value, this experiment uses a 12-input size for the multi-head self-attention mechanism section of the model.

### 5. Conclusion

As the initial link in the chain of lifelong education, the development of ECE informatization has grown in significance and is now an integral part of the national education informatization building. In order to better realize the gamification of ECE curriculum and strengthen the management and deepening of curriculum resources, this paper analyzes the significance of the application of early childhood game teaching and the application methods of new media resources in the gamification teaching of early childhood curriculum, taking into account the current educational environment and the teaching advantages of new media resources, and studies the application methods. The paper proposes a mobile application-based ECE system and a recommendation algorithm based on a multi-attention mechanism to recommend appropriate reading materials for young children, in light of the fact that current ECE products on the market do not fully meet the functional and technological requirements of ECE information construction. Experiments conducted on publicly accessible data sets reveal that the technique described in this paper outperforms the benchmark algorithm by a significant margin. Graph neural networks and knowledge graphs can help improve the accuracy of recommendation algorithms. In the future, we will try to incorporate these techniques into our method.

### Data Availability

The data used to support the findings of this study are available from the author upon request.

### Conflicts of Interest

The author declares that he has no conflicts of interest.

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