Innovation of teaching mode of economic management informationization in colleges and universities based on the RDMIE model

Fukang Deng¹, Xiaofang Chen¹,†

1. School of Management, Suzhou University, Suzhou, Anhui, 234000, China.

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Abstract

The accelerated application of emerging technologies in the financial field in the era of informationization has put forward brand-new challenges and requirements for the development of disciplines as well as the teaching mode of economics and management majors in colleges and universities. In this paper, the teaching resource base of economics and management majors is first constructed on the basis of the RNMIE model combined with cloud computing and other technologies. Then the theory of self-organizing behavior is introduced to build a three-dimensional informatization teaching platform for economics and management majors. On this basis, combined with the online learning teaching resources analysis model, the personalized recommendation method of hybrid recommendation is used to recommend matching resources for economics and management students. The learning satisfaction assessment model is constructed with the students’ learning satisfaction assessment system and structural equation model. Simulation tests and example analyses were conducted to recommend resources and ensure student satisfaction in the three-dimensional computer-based teaching platform for economics and management in colleges and universities. It is found that when the number of nearest neighbors increases from 5 to 50, the MAE of personalized recommendation of economic and management teaching resources based on hybrid recommendation decreases by 30.91%, and the direct utility path coefficient of teaching effect on students’ learning satisfaction is 0.62. The teaching resources of economics and management constructed by combining the RNMIE model can help students realize the diversified choices of teaching resources and also provide a new reference for the innovative informationized teaching mode of economics and management majors.

Keywords: RDMIE model; Hybrid recommendation; Structural equation modeling; Learning satisfaction; Economic management.

AMS 2010 codes: 68T05
1 Introduction

Vigorous development of education is an objective need for economic and social development. The students trained in financial management in colleges and universities must master the basic theories and professional knowledge of the specialty, have the comprehensive ability to engage in the practical work of the specialty, and are technical and applied talents who are up-to-date and able to work in the front line [1-3].

With the development of China’s economy and society and the deepening reform of the economic system, enterprises are beginning to realize the importance of economic project management talents [4-5]. The teaching of economic management courses bears the important responsibility and mission of cultivating relevant talents, which not only requires students to master enough theoretical knowledge of scientific management and economic science but also to have the basic skills of economic management and the ability to practically apply theoretical knowledge [6-7]. In order to adapt to the development and progress of the times, the teaching of economic management courses in colleges and universities should follow in the footsteps of social development, actively innovate the teaching mode, and enrich the teaching content [8]. However, due to the knowledge involved in economic management, students have great difficulty in learning, which leads to many problems in the teaching of current economic management courses [9].

The rapid development of China’s economy further improves the requirements of economic management talents, and the reality requires universities to innovate the teaching mode in the teaching of financial management courses, further enhance the quality of teaching, and cultivate high-quality economic management talents for society. Informational distance education provides a new path for the development of financial management course teaching, which is of great significance for improving teaching effectiveness [10]. Tao, T et al. combined the TPACK analytical model and the concept of constructivism to develop a framework for designing economics and management courses, which promotes the enhancement of the teaching effect and obtains the general acceptance of students [11]. Zhang, C et al. based on the perspective of the Internet Zhang, C et al. proposed a teaching method for economics and management courses with hierarchical analysis as the core technology, which effectively improved the teaching level of economics and management courses and, at the same time, pointed out that there are deficiencies in the practice of economics and management courses [12]. Wu, D et al. adopted the optimal solution set algorithm of the multiplexed tree to design an innovative and entrepreneurial teaching system that is the most important for economics and management majors and pointed out that, compared with the traditional model, the proposed teaching and training system has a better performance in terms of talent cultivation efficiency and talent development, and has gained popular recognition among students. The traditional mode is superior in terms of talent cultivation efficiency and quality [13]. Dreisiebner, S et al. related analysis on information literacy in college teaching materials pointed out that the information literacy content and methods should be populated according to the differences and needs of subject specialties [14].

Economic management is an application-oriented specialty that mainly cultivates application-oriented talents who can be competent in the work of economic management departments and practical management. Secchi S. et al. tried to use game practice as a path of natural management teaching, and this teaching form significantly stimulated students’ interest and enthusiasm in learning and improved students’ natural management practice ability to a certain extent [15]. Wilko et al. introduced a financial and economic book that covers the creation and use of models used for economic analysis and can be regarded as an introductory book for the development of macroeconomic and financial modeling skills [16]. Winter J. et al. learned, after interviewing and examining economic and management educators, that in the teaching process of the economic and management professional courses, the concept of sustainable teaching is incorporated into the
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The syllabus. The teaching methodology remains consistent, they are still negatively affected by political and cultural systems and so on [17]. Abelson, P. et al. revealed the association between public economics teaching and social national culture while arguing that the social democratic approach to teaching economics is more suitable for the social situation in Australia [18]. Liu, M. et al. elaborated on the disruptive changes brought by Internet information technology (IIT) in the field of education, emphasizing the advantages of smart classrooms based on information Internet technology compared with traditional teaching mode, and looked forward to the future development of Internet information technology in the education industry [19].

This paper introduces the specific connotation of the RNMIE training resource development model and combines it with big data, cloud computing, and other technologies to construct a teaching resource base for economics and management, and then introduces the theory of self-organizing behavior to establish a three-dimensional informatization teaching platform for economics and management in colleges and universities. In order to realize the optimal allocation of teaching resources in economics and management, this paper uses an online learning teaching resources analysis model to mine each teaching resource. It carries out the hybrid personalized recommendations of teaching resources from the dimensions of students’ existing interest model, potential users’ interest, and fusion interest model. Furthermore, this paper develops a learning satisfaction assessment system for economics and management students and creates a student learning satisfaction assessment model that utilizes structural equation modeling. For the application of the three-dimensional informatization teaching platform for economics and management established in this paper, the validation analysis was carried out from the dimensions of teaching resources recommendation effectiveness and three-dimensional teaching satisfaction, aiming to provide a new path for the innovation of informatization teaching for economics and management majors in colleges and universities.

2 Informatization Teaching Mode of Economics and Management in Colleges and Universities

Economics and management is a highly practical discipline. Still, with the increasing development of mass higher education, especially in finance, accounting, and other majors over a long period of hot, the number of students in the school and the opportunity to contact the front line of practice is extremely scarce, the position of information technology teaching of economics and management in the cultivation of talents is also becoming more and more prominent. With the rapid development of cloud technology, multimedia and other modern technologies, informationized teaching of economics and management has gradually become an important way of teaching, and the enhancement of teaching effect depends largely on what kind of supporting informationized technology is used. Therefore, economics and management majors should focus on strengthening the high-quality construction of economics and management teaching resource libraries from the actual perspective of specific professional characteristics and their own needs so as to promote the innovation of the informationized teaching mode of economics and management majors in colleges and universities.

2.1 Instructional Resource Library based on the RDMIE model

2.1.1 RDMIE training resource development model

The structure of the RDMIE training resource development model is shown in Figure 1, which is mainly composed of five links, namely, research (R), development (D), management (M), implementation (I), and evaluation (E). Among these five links, research is the scientific basis for building a resource base, development is the main body of creating a resource base, management is
the means for sustainable utilization of a resource base, implementation is the goal of creating a resource base, and evaluation is the guarantee of continuous improvement of a resource base.

**Figure 1. RDMIE training resource development model**

Research mainly refers to the use of theoretical research, empirical research, and other methods to study the knowledge base of economics and management teaching, research on the ability quality model of university economics and management teacher team, and research on the scientific methods and construction standards of resource base construction. Development is to use the resource development platform mainly based on the Internet, to play the role of expert team, to develop a logically rigorous, scientific, and complete three-level course system of economics and management, and to create a systematic, practical, and content-rich teaching resource base of economics and management. Management is the establishment of a scientific management system using information technology to achieve efficient dynamic management of library resources. Implementation is to select the excellent course teachers in the library and apply them in the training of economics and management teachers in universities so as to realize the integrated application of quality resources in teaching and training of economics and management. Evaluation is the last link in the model, which refers to the adoption of whole-process, multi-dimensional professional evaluation in research, development, management, and implementation to improve the resource library in a timely manner.

2.1.2 Building a resource base for teaching and learning in economics and management

Connotation construction and content design are crucial to creating a practical and targeted teaching resource base. In the context of the development of the information age, the construction of the teaching resource base should consider the talent cultivation objectives, teaching programs, curriculum system, and expansion resources that are compatible with the economics and management majors. Therefore, based on the RDMIE training resource development model, this paper builds a teaching resource base for economics and management majors, as shown in Fig. 2, which is based on the "Knowledge Sharing Cloud + Open Experimental Project Resource Base + O2O Economics and Management Course Group" by means of the Internet, big data and cloud computing. The functions expected to be realized by the teaching resource base of economics and management are, firstly, to provide targeted teaching resources for economics and management professionals, learn the sharing of teaching resources, and improve the quality of teaching and talent cultivation. Secondly, it is to
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assist teaching, facilitates students’ independent learning, and provides a platform for teachers to release learning resources. Third, it provides an online communication platform for teachers and students, who can release and answer questions online through the forum module and online communication module of the resource library. Fourthly, it sets up modules of industry information, innovation, and entrepreneurship training to assist with students’ future employment and enhancement of their comprehensive quality.

![Figure 2. The teaching resource library of the tube class](image)

Under the guidance of the RDMIE training resource development model, the construction of a teaching resource base for economic and management majors is an important content of digital education resource construction for financial management in colleges and universities. The construction and use of the teaching resource base of economics and management can provide high-quality and efficient services for teaching and research of economics and management majors in colleges and universities and change the traditional teaching mode. It enhances the teaching quality of economics and management, effectively reduces the teaching burden of teachers, develops the ability of students to learn creatively, avoids the duplication of educational and teaching resources, and is of great significance in promoting the information-based teaching of economics and management in colleges and universities.

2.2 Three-dimensional teaching based on self-organization theory

2.2.1 Relevance of the Theory of Self-Organizing Behavior

Self-organization theory has become a well-established and widely applied theoretical system in the study of complex systems. According to related research, if a system obtains spatial, temporal, or functional structure without specific interference from the outside, we say that the system is self-organized. The correlation of self-organized behavioral features is shown in Figure 3, including seven self-organized behavioral features: short-range communication, information sharing, unit self-
regulation, micro-decision making, parallel operation, overall coordination, and iterative optimization. Among them, short-range communication and information-sharing principles describe the information interaction characteristics of the system’s microscopic unit, unit self-regulation, microscopic decision-making, and parallel operation are the self-organized unit behavior rules. At the same time, overall coordination and iterative optimization are the characteristics of the self-organized system as a whole.

**Figure 3. Relevant relationship of self-organizing behavior characteristics**

### 2.2.2 Constructing a three-dimensional Teaching Model for Economics and Management Classes

Self-organization theory, which is the second generation of system theory, focuses on the results of natural science research, such as dissipative structure theory, synergy, and mutation theory. Informatization teaching optimizes the teaching process by creating an open learning environment, providing rich educational resources, building an interactive communication platform, etc. It cultivates students’ comprehensive abilities such as teamwork, independent learning, practical innovation, problem analysis, and problem-solving. It can be seen that there is a fit between informatization teaching and self-organization theory, i.e. Personalization of education, interaction of teaching, and depth of learning. As a result, the professional course of economics and management uses the cloud class APP as the teaching platform. It constructs a three-dimensional teaching mode of a flipped classroom with pre-course learning, in-class discussion, and post-course enhancement, as shown in Fig. 4, which guides students to carry out in-depth processing of information, active construction of knowledge and completes the in-depth learning effect of learning, internalization, and transfer of knowledge.
1) Learning knowledge and skills before class. Teachers upload the microclasses, related knowledge videos, and pre-course tasks made by teachers to the cloud class before class so that students can study anytime and anywhere, arrange their own study time, turn the study tasks into bits and pieces, make the study time fragmented, flexible and personalized, and cultivate independent learning ability.

2) Internalize knowledge and train skills in class. Based on the nine-step teaching method, in-class teaching is divided into three stages: teaching preparation, knowledge acquisition, task performance, and knowledge retention and transfer.

3) Expanding knowledge and improving skills after class. After class, students can use an app to create mind maps to clarify knowledge points and consolidate their learning through after-class homework, communication, and Q&A through the use of economic and management teaching resource libraries, taxation classrooms, accounting online schools, and other quotes to expand the level of knowledge, students who can scan the QR code to improve their practice and disperse thinking so as to achieve the purpose of consolidating and enhancing the understanding of economic and management after class.
3 Recommendation of Information Teaching Resources for Economics and Management in Colleges and Universities

Under the network environment, the informatization of teaching content of economics and management in colleges and universities has a positive role and practical significance in optimizing the quality of teaching, popularizing educational information, and coordinating teaching resources and means, which embodies the essence of the concept of overcoming the difficulties of teaching and supporting the teaching process with new teaching resources. The informatization of teaching content of economics and management in colleges and universities based on informatization technology is a modernized teaching means that combines teaching, methods, and tools and is of great significance in improving the intangibility, inaccessibility, difficult storage, differentiation of the quality of lectures, and the separability of the two sides of the teaching process of economics and management knowledge.

3.1 Personalized Recommendation of Teaching Resources for Economics and Management

3.1.1 Model for analyzing online learning teaching resources

The flipped classroom in economics and management involves students learning pre-course knowledge through the cloud classroom, and teachers utilize online teaching resources to assist students with knowledge pre-study. College students in colleges and universities use pre-course resources, in-class learning resources, and post-course discussions on the online learning platform, which stores a large amount of learning behavior data. Depending on the source of the data, it mainly contains learners’ course resource learning scale, course resource browsing times, the type of knowledge to which the resource belongs, the length of resource learning, the way the resource is presented, the number of times the discussion forum is posted, and so on. Students’ online learning teaching resources are mainly clarified based on their behavioral attributes so as to better carry out the recommendations of teaching resources.

The analysis based on students’ online learning behavioral attributes mainly includes the following aspects:

1) Resource heat coefficient

Resource heat is a description of the access to the resource, but also a visual representation of the popularity of the resource, recorded as $H$ the value of the normalized value. 0 represents no one browsing, no heat, 1 represents a lot of people use, is a popular resource. The formula for calculating the heat of a resource is:

$$H = \frac{\sum_{i=1}^{j} (x_i - x_{\text{min}})}{(x_{\text{max}} - x_{\text{min}}) \cdot j}$$ (1)

Where $x_i$ indicates the number of times the $i$ nd course resource was accessed, $x_{\text{min}}$ indicates the number of times the least accessed resource in the course resource was accessed, $x_{\text{max}}$ indicates the number of times the most accessed resource in the course resource was accessed, and $j$ indicates the total number of course resources.

2) Resource responsiveness coefficient
Resource responsiveness is a reflection of learners’ sensitivity to the resource in time, which is denoted as $R$, and can be expressed by the time interval between the time the resource is released and the time the resource is accessed for the first time. It is expressed as:

$$R = |T_p - T_{fr}|$$  \hspace{1cm} (2)

Where, $T_p$ denotes the upload time of the resource and $T_{fr}$ denotes the time when the resource was first accessed.

3) Resource Healthiness Coefficient

Resource health is a quantitative measure of the health of a course resource and is denoted as $O_{RH}$. Then:

$$O_{RH} = \left( w_1 \ast \left( 1 - e^{-R} \right) + w_2 \ast \left( 1 - e^{-R} \right) + \left( 1 - w_1 - w_2 \right) \left( 1 - e^{-ln} \right) \right) \ast 100$$  \hspace{1cm} (3)

4) Resource Difficulty Factor

Resource Difficulty Coefficient is a description of the degree of difficulty of a course resource, denoted as $R_d$, which can be expressed by the corresponding course resource test. The smaller the difficulty coefficient is, the easier it is for learners to learn the course resources and vice versa. The course resource designer can adjust the course resource according to the difficulty coefficient of the resource in order to accommodate most of the learners. Then:

$$R_d = 1 - \frac{\sum_{i=1}^{n} R_i}{R_f \ast n}$$  \hspace{1cm} (4)

Where $R_i$ denotes the $i$th learner’s score on the course resource test, $R_f$ denotes the full score on the course resource test, and $n$ denotes the total number of people who participated in the course resource test.

5) Resource Learning Attainment Coefficient

Resource Learning Achievement Degree is a description of whether the learners have reached the suggested duration of the resource, which is denoted as $G$. The suggested duration of the resource usually refers to the duration that most of the learners have spent learning the resource. If the resource is a video-type resource, the suggested learning duration is the duration of the video itself. If the resource is a text-type resource, the suggested learning duration is the duration of the learning as indicated by the publisher of the resource. Then:

$$G = \frac{1}{m} \sum_{j=1}^{m} \left( \frac{1}{T_m} \left( \frac{1}{s} \sum_{i=1}^{n} T_n - T_m \right) \right) \text{for} (n \leq s)$$  \hspace{1cm} (5)

Where, if the resource is a video-based resource, $T_m$ indicates the video duration of the $j$th video, and if the resource is a text-based resource, $T_m$ indicates the suggested learning duration of the $j$th document; $T_n$ indicates the time spent by the $i$th learner browsing in the $j$th courseware
resource, $s$ indicates the total number of people who have selected the course, and $m$ indicates the number of course resources.

### 3.1.2 Recommendation process of personalized teaching resources

Combined with the analysis model of students’ online learning teaching resources in section 3.1.1, this paper proposes an improved algorithm for personalized recommendation based on hybrid recommendation, which introduces the user’s established interest model, potential user interest, and fusion interest on the basis of traditional collaborative filtering algorithms and content-based recommendation. The specific steps for implementing a personalized recommendation algorithm based on a hybrid recommendation algorithm are as follows:

1) Establishment of user’s established interest model (EUIM). For any user in the system, the keyword $(f_1, f_2, \ldots, f_k)$ of the user’s interest resource information, which $k$ represents the $k$ keywords of the resource, is calculated by text vectorization. The weight vector $F_i$ is obtained, and the mathematical formula can be expressed as:

$$EM = (w_{1j}, w_{12}, \ldots, w_{1j}, \ldots, w_{1k})$$  \hspace{1cm} (6)

Where $w_{1j}$ denotes the weight of keyword $f_j$ in $F$ in the established interest model EUIM.

2) Establish the user’s potential interest model (PUIM). For the users in the system, the algorithm of collaborative filtering recommendation is used to push the relevant interest resources in the neighbor set with high relevance to the target users and then get the weight vector of resource keywords. The mathematical formula can be expressed as:

$$PM = (w_{2j}, w_{22}, \ldots, w_{2j}, \ldots, w_{2k})$$  \hspace{1cm} (7)

Where $w_{2j}$ denotes the weight of keyword $f_j$ in $F$ in the potential user interest model PUIM.

3) Establishing the user’s fusion interest model (FUIM). For a system user, the existing interest model and potential interest model of the user are calculated to form a new weight vector. Finally, the fusion user interest model of the user is established. Its mathematical expression form is:

$$FM = (w_{3j}, w_{32}, \ldots, w_{3j}, \ldots, w_{3k})$$  \hspace{1cm} (8)

Where $w_{3j}$ denotes the weight of keyword $f_j$ in $F$ in the fusion user interest model FUIM.

Once the target user’s established and potential interest models are obtained, the hybrid interests can be determined by combining the weights of the two interest model feature words. Then, the main feature weight vectors of candidate educational resources are calculated for similarity using FUIM, and the calculated results are compared with the set threshold to determine the final recommendation.
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Let the established interest model of the user $u$ be $EM_u = \{w_{1u}, w_{2u}, \ldots, w_{ju}, w_{ku}\}$, the potential interest model be $PUIM = \{w_{1u}, w_{2u}, \ldots, w_{ju}, w_{ku}\}$, the candidate resource be $d = \{wd_1, wd_2, \ldots, wd_{j}, wd_{k}\}$, and the candidate resource be $d = \{wd_1, wd_2, \ldots, wd_{j}, wd_{k}\}$. Then:

$$w_{3u} = \max (w_{1u}, w_{2u})$$ (9)

Where the $\max$ function indicates that the larger of $w_{1u}$, $w_{2u}$ is recommended to the user.

3.2 A model of learning satisfaction of economics and management students

3.2.1 Measurement of Learning Satisfaction of Economics and Management Students

The three-dimensional teaching mode of economics and management information carried out under the support of the teaching resource base of economics and management based on the RDMIE model has a certain impact on students, and students will have different teaching evaluation results because of the teaching content and teaching methods when teaching economics and management courses using this teaching mode. Moreover, under the flipped teaching mode, students will also have a certain degree of satisfaction with the teaching objectives of the course and teaching management methods, which effectively enhances the teaching effect of the economics and management courses and provides support for improving students’ satisfaction. As a result, for the learning satisfaction of economics and management students to the stereoscopic teaching mode, this paper constructs a learning satisfaction evaluation index system as shown in Table 1, which mainly includes four dimensions of teaching content, teaching methods, teaching objectives, and teaching effects.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Index</th>
<th>Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>Teaching content</td>
<td>The teaching resources are rich in variety</td>
<td>TC1</td>
</tr>
<tr>
<td></td>
<td>High quality of teachers’ professional quality</td>
<td>TC2</td>
</tr>
<tr>
<td></td>
<td>The teaching equipment is effective</td>
<td>TC3</td>
</tr>
<tr>
<td>Teaching method</td>
<td>Group discussion</td>
<td>TM1</td>
</tr>
<tr>
<td></td>
<td>Student interaction</td>
<td>TM2</td>
</tr>
<tr>
<td></td>
<td>Student learning</td>
<td>TM3</td>
</tr>
<tr>
<td>Teaching target</td>
<td>The target of the tube class</td>
<td>TT1</td>
</tr>
<tr>
<td></td>
<td>The course culture goals are clear</td>
<td>TT2</td>
</tr>
<tr>
<td></td>
<td>Reasonable teaching goals</td>
<td>TT3</td>
</tr>
<tr>
<td>Teaching effect</td>
<td>Content learning satisfaction</td>
<td>TE1</td>
</tr>
<tr>
<td></td>
<td>Student interaction satisfaction</td>
<td>TE2</td>
</tr>
<tr>
<td></td>
<td>Practical teaching content</td>
<td>TE3</td>
</tr>
</tbody>
</table>

3.2.2 Modeling Learning Satisfaction in conjunction with SEM

1) Structural Equation Modeling (SEM)
There are exogenous, endogenous, latent, and manifest variables in structural equation modeling. Exogenous variables are variables that are not affected by other variables, endogenous variables are the opposite and can be affected by any variable, and latent and manifest variables refer to variables that are not directly observable and those that can be directly measured, respectively. SEM is divided into a measurement model, which reflects whether or not a measured indicator explains a latent variable, and a structural model, which demonstrates the relationship between latent variables.

The measurement model can be described as:

\[ X = \Lambda_x \xi + \delta \]  
\[ Y = \Lambda_y \eta + \epsilon \]

Where \( X \) is the exogenous explicit variable, \( \Lambda_x \) is the relationship between the exogenous explicit variable and the exogenous latent variable, \( \xi \) is the exogenous latent variable, \( \delta \) is the error term for the exogenous explicit variable, \( Y \) is the endogenous explicit variable, \( \Lambda_y \) is the relationship between the endogenous explicit variable and the endogenous latent variable, \( \eta \) is the endogenous latent variable, and \( \epsilon \) is the error term for the endogenous explicit variable.

The structural model can be expressed as:

\[ \eta = B\eta + \Gamma \xi + \zeta \]

Where \( \eta \) is the endogenous latent variable, \( B \) is the relationship between endogenous latent variables, \( \Gamma \) is the effect of exogenous latent variables on endogenous latent variables, \( \xi \) is the exogenous latent variable, and \( \zeta \) is the residual term.

2) Model of students’ online learning satisfaction

Based on the index system for measuring students’ learning satisfaction in section 3.2.1, a structural model for the learning satisfaction of economics and management students was constructed by combining structural equation modeling, as shown in Figure 5. Teaching content, teaching methods, and teaching objectives are taken as exogenous latent variables of the model, and student satisfaction and teaching effect are taken as endogenous latent variables.

Figure 5. Student Satisfaction Structure Model
4 Flipped Teaching Practice of Economics and Management Courses in Colleges and Universities

With the rapid development of mobile Internet today, the teaching content and process of information technology education also need to be changed. Through three-dimensional information, teaching can make students run on the track with the teacher’s lectures individually so that they can understand the essence of economics and management courses more intuitively, promote the improvement of students’ professional knowledge and comprehensive quality, and better meet the needs of social development and enterprise employment. The application of informatization teaching in the teaching of economics and management courses in colleges and universities can make teaching and learning more closely linked together. The form of teaching and learning is more flexible and diversified, providing a guarantee for the enhancement of the teaching effect of economics and management majors in colleges and universities.

4.1 Effectiveness of Recommended Teaching and Learning Resources in Economics and Management

The purpose of using the personalized recommendation algorithm in the three-dimensional teaching platform of economics and management is to help students obtain teaching resources in economics and management that meet their personalized learning needs. In order to verify the effectiveness of the method, this paper relies on the relevant economics and management resources collected by the three-dimensional teaching platform of economics and management as a dataset, which is encoded and classified to measure the similarity of students’ resource preferences. The experimental data are randomly divided into training sets and test sets according to the ratio of 8:2, and the number of nearest neighbors and the average absolute error is chosen as the evaluation indexes to illustrate the effectiveness of this paper’s method in the recommendation of economic and management teaching resources.

4.1.1 Efficiency of nearest neighbor queries

When recommending the teaching resources of economics and management to students, it is through a collaborative filtering recommendation algorithm to push the related interest resources in the set of neighbors with a high degree of relevance to the target users and then get the weight vector of resource keywords, and group the users with similar resource attribute preferences into the same cluster. Different numbers of clusters of nearest neighbors may lead to a certain clustering error caused by multiple iterative calculations, which can not effectively ensure the accurate recommendation of teaching resources in the class of economics and management. Thus, this paper investigates the clustering of the set of users when the number of clusters of the nearest neighbors is 20, 30, 40, 50, and 60, respectively, and the query efficiency of the search for nearest neighbors based on the hybrid recommender algorithm is shown in Fig. 6.

As can be seen from the figure, the percentage of neighbors searched increases with the percentage of users searching throughout the space, and the increase gradually decreases and eventually levels off. Since the 40 nearest neighbors of the target user are almost contained in several clusters near the user, there are very few neighbors of the target user in other clusters. When the number of clusters is 40, when searching, 40% of the users can find about 56.78% of the nearest neighbors, and searching 90% of the users can find 83.43% of the closest neighbors. Thus the user’s potential interest model can query as many nearest neighbors of the target user as possible on as little user space, which can improve the real-time response speed of the recommender system to some extent. Therefore, the
number of nearest neighbors is set to 40 in all subsequent experiments as a way to achieve the optimal efficiency of personalized recommendations for teaching resources in economics and management.

Figure 6. Recently neighbor’s query efficiency

4.1.2 Effectiveness of Recommendations for Teaching Resources

In order to test the effectiveness of personalized recommendation of teaching resources in economics and management based on hybrid recommendation, the method of this paper is compared with traditional collaborative filtering algorithm (TCF), collaborative filtering algorithm based on pre-population of resource rating mean (CFBRF), and collaborative filtering algorithm based on user (CF-User), and the average absolute error value of the recommendation of teaching resources is compared with the rest of the situation is the same. In the experiment, the number of nearest neighbor users is set at 5 to 50, and Figure 7 illustrates the comparison results of the recommendation algorithms.

As can be seen from the figure, as the number of nearest neighbors increases, the MAE of the four recommendation algorithms for the recommendation of teaching resources in the class of economics and management decreases, with a large change in the beginning, and then flattens out in the end. For the personalized recommendation algorithm of teaching resources based on the hybrid recommendation proposed in this paper, when the number of nearest neighbors increases from 5 to 50, its MAE decreases from 0.728 to 0.503. The overall decrease reaches 30.91%, which is lower than the other three algorithms by 14.27, 15.12, and 15.45 percentage points, respectively. Selecting different numbers of nearby neighbors, the algorithms proposed in this paper are able to further reduce the recommended MAE values of teaching resources in economics and management. This indicates that the personalized recommendation algorithm for economic and management teaching resources based on hybrid recommendation can better overcome the disadvantages of traditional algorithms and improve the recommendation accuracy for economic and management teaching resources.
Relying on the three-dimensional teaching platform of economics and management can provide students with diversified teaching resources of economics and management courses, combined with the personalized recommendation method given in the previous section, which can help provide students with diversified teaching resources and enhance their comprehension of economics and management knowledge when carrying out the learning of economics and management knowledge.

4.2 Satisfaction with three-dimensional teaching and learning in economics and management

4.2.1 Study Population and Questionnaire Distribution

The survey object of this study is all the undergraduate students enrolled in the economics and management majors of S universities, and the survey form adopts the network questionnaire star, which covers all the undergraduate majors of economics and management in the whole university, and 647 valid questionnaires are retrieved. This survey uses the Teaching Quality Satisfaction Questionnaire, which has three parts: basic information, teaching quality satisfaction survey, and open-ended question survey. Among them, the Teaching Quality Satisfaction Survey includes five dimensions: curriculum and teaching content, teachers and teaching methods, teaching objectives, and teaching effects, and the content of the specific questions is the same as that of the satisfaction assessment system in the previous section. The questionnaire adopts the Likert 5 scoring method, i.e., 1~5 represents very dissatisfied, dissatisfied, basically satisfied, satisfied, and very satisfied, respectively. In this study, the questionnaire was tested for reliability and validity. The questionnaire’s Cronbach $\alpha$ value was 0.934, and the KMO test value was 0.941, which was greater than 0.85, with high reliability and validity. In this paper, SPSS software and AMOS software were used to analyze the data collected from the survey samples.

4.2.2 Validation factor analysis

The great likelihood estimation method was chosen to conduct a validation factor analysis using AMOS software. The observed variables were tested by examining their factor loading coefficients, combined reliability (CR), and average variance extracted (AVE). Table 2 displays the validation factor analysis results.
CR reflects the degree of consistency of the observed variables below each latent variable in reflecting the same construct; the higher the CR value indicates the higher the internal consistency of the build and the higher the degree of convergence, and it is generally believed that a CR greater than 0.6 indicates a good degree of convergence. From the data in the table, the CR values of teaching content, teaching methods, teaching objectives, and teaching effects are 0.932, 0.918, 0.927, and 0.906, respectively, which are all greater than the standard of 0.6, which determines the internal consistency reliability of the student satisfaction measurement model designed in this paper. In addition, the AVE value reflects the explanatory ability of the observed variables to the latent variables, the higher the AVE value proves, the stronger the explanatory ability, and in general, the critical value of AVE is 0.55. The table shows that the AVE value of each latent variable is higher than the criterion of 0.55, which determines the convergent validity of the model. Synthesizing the results of the validation factor analysis, the data obtained from the questionnaire of this paper’s research has good validity and can truly reflect the satisfaction of college economics and management students with the stereoscopic teaching platform.

Table 2. Validation factor analysis results

<table>
<thead>
<tr>
<th>Variable</th>
<th>Code</th>
<th>Factor load</th>
<th>CR</th>
<th>AVE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Teaching Content</td>
<td>TC1</td>
<td>0.778</td>
<td>0.932</td>
<td>0.835</td>
</tr>
<tr>
<td></td>
<td>TC2</td>
<td>0.702</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>TC3</td>
<td>0.765</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Teaching Method</td>
<td>TM1</td>
<td>0.905</td>
<td>0.918</td>
<td>0.824</td>
</tr>
<tr>
<td></td>
<td>TM2</td>
<td>0.789</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>TM3</td>
<td>0.873</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Teaching Target</td>
<td>TT1</td>
<td>0.897</td>
<td>0.927</td>
<td>0.868</td>
</tr>
<tr>
<td></td>
<td>TT2</td>
<td>0.728</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>TT3</td>
<td>0.774</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Teaching Effect</td>
<td>TE1</td>
<td>0.945</td>
<td>0.906</td>
<td>0.847</td>
</tr>
<tr>
<td></td>
<td>TE2</td>
<td>0.904</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>TE3</td>
<td>0.928</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

In addition, this paper also examines the fitness of the student satisfaction assessment model, and the fitness test of structural equation modeling usually uses the absolute fit index (CMIN/DF), goodness-of-fit index (GFI), relative fit index (NFI, TLI, CFI), square root of the error of approximation (RMSEA), and the root mean square of the residuals (RMR), and so on. Table 3 shows the results of the fit test for the student satisfaction assessment model.

Before using the model correction index to correct the model, the index values of CMIN/DF, GFI, NFI, TLI, and RMSEA of the model were 3.104, 0.745, 0.737, 0.612, and 0.693, respectively, which did not reach the excellent level of fit. As a result, this paper uses the model correction index to correct the model, and after correction, a more satisfactory model index is finally obtained. As can be seen from the data in the table, the model, except for the RMSEA, which is slightly higher than the good critical value of 2%, the other indexes have reached an excellent level of fit. Therefore, the proposed model of student satisfaction in this paper fits well with the actual observed data.
Innovation of teaching mode of economic management informationization in colleges and universities based on the RDMIE model

Table 3. Satisfaction model fitting index

<table>
<thead>
<tr>
<th>Index</th>
<th>Standard</th>
<th>Prefix</th>
<th>Corrected</th>
<th>Fitting level</th>
</tr>
</thead>
<tbody>
<tr>
<td>CMIN/DF</td>
<td>&lt;2.5</td>
<td>3.104</td>
<td>2.013</td>
<td>Excellence</td>
</tr>
<tr>
<td>GFI</td>
<td>&gt;0.80</td>
<td>0.745</td>
<td>0.892</td>
<td>Excellence</td>
</tr>
<tr>
<td>NFI</td>
<td>&gt;0.80</td>
<td>0.737</td>
<td>0.867</td>
<td>Excellence</td>
</tr>
<tr>
<td>TLI</td>
<td>&gt;0.80</td>
<td>0.612</td>
<td>0.874</td>
<td>Excellence</td>
</tr>
<tr>
<td>CFI</td>
<td>&gt;0.80</td>
<td>0.889</td>
<td>0.905</td>
<td>Excellence</td>
</tr>
<tr>
<td>RMSEA</td>
<td>&lt;0.05</td>
<td>0.693</td>
<td>0.051</td>
<td>Good</td>
</tr>
<tr>
<td>RMR</td>
<td>&lt;0.05</td>
<td>0.031</td>
<td>0.019</td>
<td>Excellence</td>
</tr>
</tbody>
</table>

4.2.3 Results of structural equation modeling

Based on the model of learning satisfaction of economics and management students in section 3.2.2, the AMOS software was used to solve the corresponding path coefficients of the model, resulting in the fitting results of the structural equation model, as shown in Figure 8.

1) The correlation coefficients between teaching content, teaching methods, and teaching objectives all reach above 0.75 (P<0.01), indicating that there is an interactive relationship between the three. It is concluded that the low updating of teaching content, on the other hand, affects the formulation of teaching methods and, at the same time, limits the degree of achievement of teaching objectives to a certain extent. Teaching objectives determine the configuration of teaching content and the selection of teaching methods, and teaching methods influence the degree of achievement of teaching objectives by improving the practicality, applicability, and efficiency of use and, at the same time, realizing the full utilization of teaching content.

2) The path coefficients of teaching content and teaching effect on student satisfaction are 0.56 (P<0.01) and 0.62 (P<0.01), respectively, and both of them have a positive influence on student satisfaction. Teaching content is the basis of course conduct; the type of learning resources, the quality of the teaching team, and the sense of teaching form experience all affect students’ satisfaction with the teaching mode of economics and management. In the three-dimensional teaching of economics and management, the updating of teaching content and the choice of teaching methods are important teaching resources, and students attach more importance to the sense of using and experiencing teaching resources in the learning process.

3) The interrelationships among the potential variables in the model are all significant at the 1% level, indicating that students’ overall satisfaction with the three-dimensional teaching model of economics and management is influenced by teaching content, teaching effectiveness, teaching methods, and teaching objectives. Teaching effectiveness is the mediating variable between teaching methods and teaching objectives. When it comes to model utility, the teaching effect has the most direct impact on student satisfaction, with a path coefficient of 0.62, followed by teaching content. The indirect and total utility of teaching objectives on students’ overall satisfaction is the largest, reaching 0.73. This shows that students’ overall satisfaction with the three-dimensional teaching model of economics and management mainly stems from the direct utility generated by teaching effects and the indirect utility generated by teaching objectives through influencing teaching effects.
5 Conclusion

This paper establishes a teaching resource base of economics and management based on the RNMIE model and constructs a three-dimensional information teaching model of economics and management by combining with the theory of self-organizing behavior, realizes the personalized recommendation of teaching resources of economics and management by using the hybrid recommendation method, and analyzes the students’ satisfaction to the three-dimensional information teaching model through the structural equation model. The conclusion is as follows:

1) When the number of clusters of nearest neighbors is 40, 56.78% of nearest neighbors can be found by searching 40% of users, and 83.43% of nearest neighbors can be found by searching 90% of users. When the number of nearest neighbors is increased from 5 to 50, the MAE value of personalized recommendations for teaching resources in economics and management is reduced by 30.91%. The customized recommendation method based on hybrid recommendation can help students obtain the economic and management teaching resources that better meet their needs in the three-dimensional teaching platform and promote the diversification of students’ financial and management learning resources.

2) In the three-dimensional information teaching of economics and management majors, the direct utility path coefficient of teaching effect reaches 0.62. The indirect effect coefficient of teaching goal is 0.71, reflecting that the three-dimensional information teaching of economics and management majors needs to focus on the consideration of teaching effect and teaching goal, which can provide a guarantee for the promotion of innovative development of information teaching mode of economics and management majors.
References


