IEEE Access
Multidisciplinary ⋮ Rapid Review ⋮ Open Access Journal

Received 14 December 2023, accepted 31 December 2023, date of publication 4 January 2024,
date of current version 10 January 2024.

Digital Object Identifier 10.1109/ACCESS.2024.3349979

RESEARCH ARTICLE

Influence of College Teacher's Instructional Design on the Development of College Students' Thinking of Innovation Multi-Algorithms Perspective Analysis

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ABSTRACT At present, innovation courses for college students play a vital role in universities. It has also become an important teaching platform for cultivating superior talents. How to improve the level of innovative thinking of college students into high-quality national strategic talents has become a research topic of great concern. However, many university teachers still follow traditional instructional design. It is impossible to implement a customized approach to education. Responding to the deficiencies in the instructional design of innovative training for university students, the support vector machine and K-means clustering algorithms are combined to create a revolutionary network instructional system, which is then used in an undergraduate course. A virtual reality classroom, real-time chat features, and an evaluation system are just a few of the elements that make up this system. It makes it possible to personalize learning, share open data, have real-time debates, and participate in a variety of virtual learning activities. Through the use of conventional datasets, this integrated multi-algorithmic system's dependability is illustrated. It can meet the diverse learning needs of college students and help solve the weaknesses of traditional instructional design. Since 2022, four evaluation techniques have been used to confirm the efficacy of this teaching strategy: student recognition analysis, final test passing rate, competition winning percentage, and classroom activity level assessment. The results support the following: Compared with the traditional teaching design, the novel network instructional system is more conducive to helping college students cultivate learning interests and enhance their innovative thinking level. The adoption and dissemination of this strategy will undoubtedly advance educational research and improve college students' capacity for creative thought, fostering the development of top-notch creative talent and advancing sustainable societal development.

INDEX TERMS Instructional design, support vector machine, K-means clustering, innovative thinking, instructional system.

I. INTRODUCTION

The development of college students' innovative thinking refers to the thinking process in which college students seek and find unique and practical solutions based on systematic thinking and unconventional thinking [1], [2], [3]. Innovative thinking can facilitate the enhanced adaptation of college students to future career and social challenges, thereby fostering their development into indispensable innovative talents sought after by the nation [4], [5], [6]. At present, higher education plays an increasingly important role in promoting college students' innovative thinking and practice [7], [8]. Especially in the stage of higher education reform and transformation, it has become an important mission as well

The associate editor coordinating the review of this manuscript and approving it for publication was Qilian Liang.

TABLE 1. Comparison of different instructional designs.

Author	Instructional designs	Effect	Advantages	Insufficient
[13]–[17]	Reverse teaching Practical teaching Situational teaching Adaptive teaching	Novelty in instructional design. Enhancing college students' interest in learning and problem-solving skills	Novelty Practicality Innovative	Insufficiently targeted by generalizing to all students; less intuitive by presenting data electronically and on paper
[18]–[24]	Web-based teaching and learning Algorithm-assisted teaching Data analysis teaching Educational game teaching Programming teaching	Use big data and algorithms to identify students' learning needs and learning behaviors. Implement targeted instruction to improve the independent thinking skills of diverse students	Target-oriented Diversity	Single algorithm, less customization

as development direction of higher education to cultivate college students' innovative thinking [9]. Nevertheless, the fixed instructional design and traditional thinking make it impossible to provide targeted learning guidance to college students. In details, it restricts the innovative ability and thinking development of college students. Constructing an innovative and flexible teaching mode to enhance the innovative thinking ability of college students is an urgent problem to be solved.

In order to transfer the teaching mode and optimize the teaching method, scholars at home and abroad have done extensive research [10], [11], [12]. Shinchan et al. [13] proposed a teaching method that integrates reverse teaching and horizontal thinking to promote students' creative thinking. Kuo et al. [14] explored the combination of project-based learning (PBL) and design thinking (DL) to improve students' motivation and innovative thinking ability. The results showed that the combination of DL and PBL teaching effectively improved students' fluency, originality, and flexibility. Yu et al. [15] constructed a programming teaching classroom integrating the theory of precision teaching. It improved college students' programming knowledge mastery and programming problem-solving ability. Furthermore, Li et al. [16] constructed a contextualized instructional design. Cultivating students' critical thinking with a virtual learning environment. Refat et al. [17] utilized an adaptive instructional design to increase the motivation of the students. Nevertheless, the above teaching design has made a great contribution to the transformation of the teaching mode. However, it fails to make targeted teaching according to the different characteristics of students. It is difficult to meet the learning needs of college students. Moreover, the teachers' learning resources are presented in a single way, which cannot present the core resources to college students in an intuitive form.

With the development of computer technology, big data, algorithms, as well as network-assisted teaching have become possible. By analyzing the learning data of college students, the best learning path can be developed to meet the personalized learning needs of college students. Lin et al. [18] explored the impact of online teaching on students' creativity and learning outcomes. The results showed that online teaching methods improved students' creativity. Rafique et al. [19] developed a system that predicts student performance. Helping teachers to introduce timely corrective interventions to improve the performance of underperforming students. Jie et al. [20] used data mining techniques to analyze students' learning behavior data. Students' learning needs and learning behavior patterns can be identified and predicted. Provide a basis for teachers to adjust course content and teaching strategies. Alam et al. [21] combined with the field of Artificial Intelligence (AI), studied the influence of educational games on the development of students' innovative thinking. The results showed that online classroom educational games can attract young people's attention and achieve cognitive development. Chen et al. [22] constructed a programming teaching model based on a scratch modular programming course. Deep learning theory is utilized to analyze and evaluate the effectiveness of the designed teaching model. The results showed that students' algorithmic thinking, critical thinking, collaborative thinking, and problem-solving thinking dimensions have been effectively improved. Xiang et al. [23] designed a resource-matching model based on machine learning by utilizing a machine learning algorithm. The best resource-matching results of the better intelligent education system were obtained. Through the analysis of students' learning behavior and learning situation, personalized learning content and resource recommendations were provided for students. Xu et al. [24] investigated a particle swarm optimization neural network-based sports performance prediction method for college students. It enables students to take on a more prominent role and foster interest in learning. The instructional design described above makes a great effort to personalize the matching of resources. Nevertheless, the use of a single instructional model resulted in a low level of personalization.

As depicted in Table 1. Although predecessors have done extensive research on the development of college students' innovative thinking by instructional design. Nevertheless, combined with the current national goal of promoting

individualized, conscious, innovative, and diversified development of education, there are still short-comings. It is mainly reflected in the following aspects. Teaching methods are poorly customized and less intuitive, and algorithms are more homogeneous. Therefore, given the development of college students' innovative thinking, research on its multi-algorithm, visualization, and personalized instructional design has become an urgent problem to be solved.

To deal with this challenge, this paper focuses on a certain undergraduate class and fuses the K-means clustering algorithm and support vector machine algorithm. Besides, an instructional design system with high personalization, high visualization level, and integration of multiple algorithms is studied. It can realize personalized learning customization, diversified algorithm integration, visual teaching design, and rich teaching resources. Four learning indicators are used to evaluate the effectiveness of this design. The influence of this design system on the development of college students' innovative thinking is studied qualitatively and quantitatively by the pass rate of the final exam, the proportion of winning prizes in the competition, classroom activity, and students' recognition.

II. METHODOLOGY

A. RESEARCH FRAMEWORK OF CLUSTERING ANALYSIS ALGORITHM BASED ON K-MEANS

K-means clustering analysis algorithm is a common unsupervised learning algorithm. It is used to divide similar data points into the same cluster, which can be used for data mining and pattern recognition [25], [26], [27]. The core idea of the K-means clustering algorithm is to calculate the similarity between data points. According to the requirement of clustering number K, the data points are divided into K clusters.

Teachers find and collect data sets of college students' learning. Data processing and analysis are carried out for different fields and problems. Secondly, teachers need to determine the number of clusters and determine the K value. Subsequently, the K-means clustering analysis algorithm is utilized to cluster the students' learning data. The generated classification results and classification data can achieve targeted and personalized teaching (Figure 1) [28], [29].

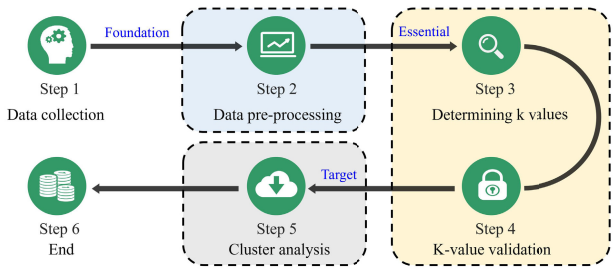

FIGURE 1. The workflow of the K-means clustering algorithm.

The Euclidean distance formula is usually used to calculate the distance in the K-means clustering algorithm, that is:

$$d_{ij} = \sqrt{\sum_{k=1}^{n} (x_{ik} - x_{jk})^2} \tag{1}$$

where, x_{ik} represents the $k-th$ feature of the $i-th$ data point, and x_{jk} represents the $k-th$ feature of the $j-th$ cluster center.

For the $i-th$ data point, the probability that it belongs to the $j-th$ cluster can be calculated using the following formula:

$$p_{ij} = \begin{cases} 1 & i \in R_j \\ 0 & i \notin R_j \end{cases} \tag{2}$$

where, R_j denotes all data points in the $j-th$ cluster.

For the center position of the $j-th$ cluster, the following formula can be used to calculate:

$$\mu_j = \frac{\sum_{i=1}^{n} p_{ij} x_i}{\sum_{i=1}^{n} p_{ij}} \tag{3}$$

where, μ_j represents the center of the $j-th$ cluster and the feature vector of the $i-th$ data point of x_i.

The essence of Eq. (1) is actually to find k clustering centers. It makes the process of minimizing the Euclidean distance between a data point and its nearest clustering center. The K-mean clustering algorithm can be thought of as a gradual descent process. It starts with initial clustering centers and iteratively updates these clustering centers. The objective function in equation (1) is reduced. The main steps are as follows: 1) Randomly select K data points as initial clustering centers; 2) Assign each data point to its nearest clustering center; 3) Update the clustering centers; 4) Repeat steps 2-3 until the clustering centers are no longer significantly changed or a predetermined number of iterations is reached. 5) K value is determined. Finally, the student's information is categorized by the determined K-value.

B. REGRESSION ANALYSIS ALGORITHM BASED ON SUPPORT VECTOR MACHINES (SVM)

The SVM regression analysis algorithm performs regression analysis by minimizing the balance between prediction error and model complexity [30], [31], [32]. In SVM regression, sample points (data) are regarded as points in a multidimensional space. The purpose of SVM regression is to find an optimal separating hyperplane. The space is divided into two parts so that the data points of the two parts can be correctly classified. Some support vectors (sample points closest to the hyperplane) can be found on both sides of the hyperplane, which are used to calculate the decision boundary of the hyperplane. The advantages of SVM regression are high generalization ability and good classification performance. It performs well in dealing with small sample, nonlinear, or high-dimensional classification problems [33], [34].

For a linear regression problem, the goal is to find a hyperplane. The distance between any data point and its nearest hyperplane is as small as possible. At the same time, the error between the data points divided by the hyperplane should be

as small as possible while keeping the distance as small as possible. Therefore, the objective function can be expressed as follows:

$$\min_{w,b} \frac{1}{2} \|w\|^2 + C \sum_{i=1}^{m} \zeta_i \tag{4}$$

where w represents the weight vector, b represents the offset, and ζ is the slack variable, representing the distance from the data point i to the hyperplane. The constant C is a positive constant, which is used to balance the distance and error.

In SVM regression, a kernel function is used to map data points from low-dimension to high-dimension space, to find an optimal separation hyperplane better. The commonly used kernel functions include linear kernel function, polynomial kernel function, radial basis function (RBF) kernel function, etc. Among them, the formula of the RBF kernel function is:

$$K(x_i, x_j) = \exp(-\frac{\|x_i - x_j\|^2}{2\sigma^2}) \tag{5}$$

where x_i, x_j are sample eigenvectors, and σ is the parameter that controls the distance of the function.

The SVM regression analysis algorithm is used for teaching design to help teachers better understand students' innovative thinking level (Figure 2). According to the learning level, learning progress, and learning preference of different college students, a teaching plan is formulated to match them [35], [36], [37], [38].

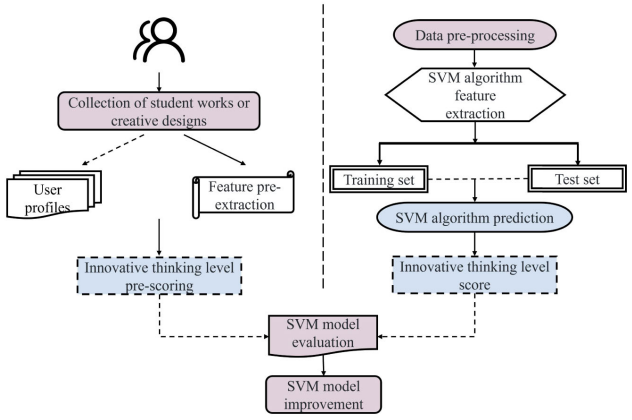

FIGURE 2. The workflow of SVM regression analysis algorithm.

C. SYSTEM DATABASE DESIGN

The K-means clustering analysis algorithm and SVM regression analysis algorithm are integrated into the novel network instructional system. It can improve the systematic teaching effect and the development of college students' innovative thinking. Database design needs to consider the following factors [39], [40], [41], [42] (Figure 3):

a) Student information: including basic information of students, students' classes, students' competitions, etc.

b) Teacher information: including basic information of teachers, teaching plans, teaching resources, teaching feedback, etc.

c) Course information: including basic course information, course plan, course resources, virtual classroom, etc.

d) Students' homework data sheet: including students' homework, competition results and other information.

e) Database relationship: including the relationship between students and courses, the relationship between teachers and courses, the relationship between students and teachers, etc., which can be designed by using a relational database management system.

f) Multimedia information: including video, audio, pictures, words, and other teaching resources uploaded by teachers, which can be stored and managed by streaming storage technology.

g) Database backup and recovery: backup by combining incremental backup and full backup.

h) Database monitoring: there may be various problems in the operation of the database, such as deadlock and cache invalidation. These problems need to be preprocessed in the system design stage, and the database system should be monitored, and the performance analysis and optimization should be carried out regularly.

In particular, student performance data were derived from six course grades, three interest profiles, and three best outcomes for 36 students. These data were collected from online forms. Data are based on college students' major characteristics. It contains 1) math, physics, computer, English, chemistry, and politics course grades; 2) three key interest characteristics (e.g., math, aviation, and economics); and 3) three best achievements (e.g., first prize in math competition, patents for inventions in the math direction, and dissertations in the math direction). The data is divided into two semesters. 75% of the data from the first semester is used as training data and 25% of the data is used as validation data. The data from the second semester is predicted using the validated model.

D. DESIGN OF NOVEL NETWORK INSTRUCTIONAL SYSTEM

In order to improve college students' innovative thinking, a novel network instructional system is designed. It integrates SVM regression analysis algorithm and K-means clustering analysis algorithm. This system can analyze and predict according to the innovative ability and characteristics of different students. Then design a personalized innovative teaching scheme to match innovative thinking courses, activities and projects.

In addition, the system can also provide corresponding online learning resources and online interactive groups. It can guide students to study and innovate independently. Through multi-angle and multi-level learning support, students' independent innovation ability is stimulated and their innovative thinking level is improved. The specific design is shown in Figure 4 below.

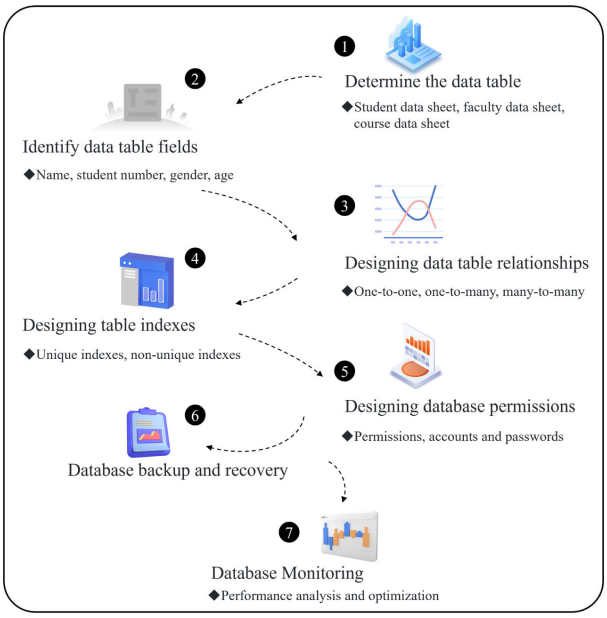

FIGURE 3. Database design of novel network instructional system.

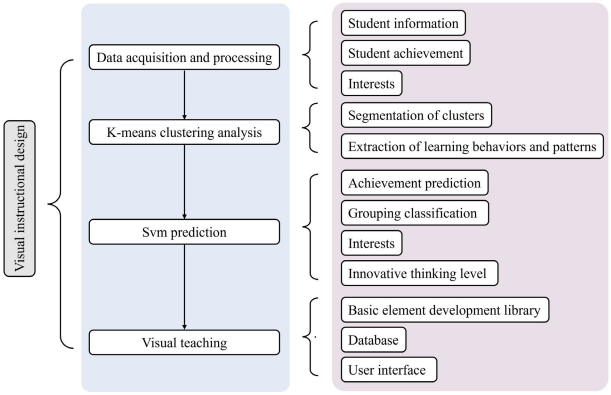

FIGURE 4. Innovative thinking visualization teaching design for college students.

The first step is data collection and preprocessing: firstly, data need to be collected and prepared, including students' personal information, academic performance, hobbies and so on.

The second step is to combine the clustering analysis algorithm and SVM regression analysis algorithm. The two algorithms are embedded inside the system and work interactively with the database. Its working sequence can be realized by the following steps: first, the learning characteristics of different students are extracted in the database. Then, the K-mean clustering algorithm is utilized to identify groups of students with similar characteristics. Second, multiple personalized SVM regression models are built using the SVM regression analysis algorithm. The learning content of the students in the group is predicted based on their feature vectors and clustering categories. In addition, when there is a change in student information or a new student enters the system, a clustering algorithm can be used to determine which group he or she belongs to. Based on the group they belong to, the corresponding SVM regression model is selected. The model is used to predict the teaching content or recommended resources that the student may be interested in. Most importantly, feedback information from students, such as their reaction to the pushed content and their learning progress, is collected and used to continuously optimize and adjust the model. The third step is to adopt a visual teaching design: visualize the students' achievements and analyze the results. In the design, the basic elements are used to develop the library, and the data and results are displayed by visual charts.

The function of basic element development library is to provide some predefined basic elements for algorithm visualization designers. It makes it easier to build a user interface for visualization algorithms (Figure 5). These basic elements can be different types of graphics, lines, labels, buttons and other common basic elements. At the same time, due to the existence of the basic element development library, designers can avoid reusing and designing the same or similar basic elements in the visual design process of the algorithm. This can improve work efficiency and keep the design of algorithm visualization unified. For example, use a stacked histogram or radar chart to show the differences between different groups; show the distribution and correlation of students' characteristics with a scatter diagram or heat map; use basic elements such as text labels and arrows to identify students' personal information, recommended courses or training plans.

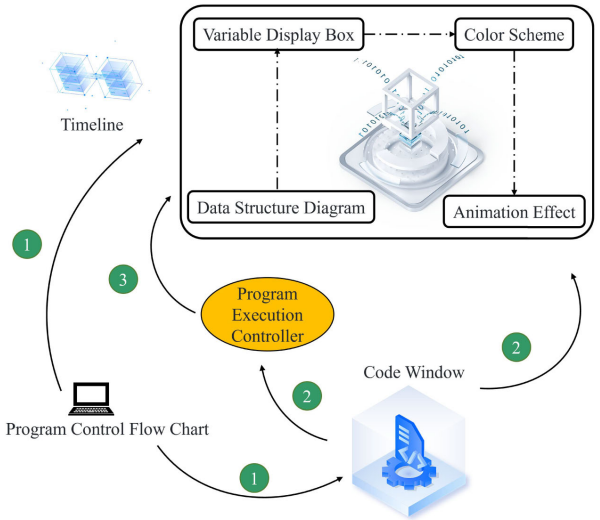

FIGURE 5. Design of visual basic element library.

III. EXPERIMENT

A. TEACHING PLATFORM FRAMEWORK

Three fundamental components make up the platform: data, algorithms, and evaluation. In the teaching process, the data layer is in charge of gathering, condensing, and organizing

various sorts of data. including the academic progress, study habits, and test scores of college students. K-means clustering and SVM regression analysis technologies form the foundation of the algorithm layer. Give pupils individualized instruction and learning based on their learning styles. Its primary function is to develop a network of knowledge for learners by analyzing the interests of college students. Provide learners with individualized and focused learning materials and answers, and aid college students in the development of creative thinking. The assessment layer receives the algorithm layer's processing findings, gives students an original thinking evaluation, and implements tailored and difficult adaptive learning for pupils.

Four parts make up the platform: real-time chat, VR virtual classroom, personalized learning customization, and an evaluation system. In a setting where virtual and real worlds are integrated, college students can experience flexible, interactive, open, intuitive, and diversified learning. Teachers enter information through the teaching platform, and depending on the data gathered and clever algorithms, they supply pupils with distinct learning needs. Teachers can continuously modify and enhance their teaching strategies while using the platform based on platform feedback, student participation, and learning progress. Realize personalized adaptive learning for pupils and teach students following their aptitude.

The functions of each module are as follows:

a) The personalized learning customization module mainly collects the learning data of college students and carries out personalized teaching. K-means clustering algorithm and SVM regression algorithm are used to provide different learning materials for each student according to their learning ability, learning content, and learning progress. Strengthen students' weak links and teach students to follow their aptitude.

b) VR virtual classroom is divided into two modules. On the one hand, personalized virtual learning peers. Enable college students to learn and listen to lessons with these virtual characters; On the other hand, it is to realize practical simulation. It has the functions of a virtual laboratory, virtual project book, and virtual classroom. And can realize computer teaching, practical operation, work-study combination, project orientation, productive training, post skill training. Figure 6 below shows the virtual teacher module of the teaching system. Provide an immersive learning experience for college students in the field of education. Enable students to acquire knowledge through simulation practice, improve learning efficiency, and broaden innovative thinking.

c) The real-time chat module can realize the functions of timely communication, file transfer, group chat, and interactive whiteboard. Realize the real-time interaction of college students and improve communication efficiency.

d) The evaluation system module mainly includes classroom evaluation, works exhibition, scientific research competitions, and innovative projects. It is used to evaluate the innovative thinking level of college students.

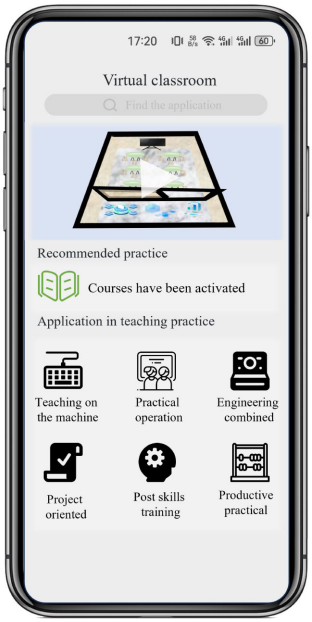

FIGURE 6. Virtual classroom interface.

B. INNOVATIVE THINKING EVALUATION MEANS

To comprehensively evaluate the development level of students' innovative thinking, the dimensions of indicators should reflect the essence of knowledge mastery, innovative ability, practical skills, and scientific research ability [43], [44], [45]. Such as students' performance in class discussions, ability to complete project works, performance of critical thinking, autonomous learning ability, cooperative learning ability, etc. In this chapter, four indicators, namely, the passing rate of the final exam, the winning proportion of the competition, the classroom activity, and the students' recognition, are considered for evaluation.

1) PASS RATE OF FINAL EXAM

The passing rate of the final examination is an important index to measure students' learning achievements and knowledge mastery. The final exam usually involves some challenging issues. Students are required to utilize the knowledge and skills they have learned to analyze, reason, and innovate in order to find solutions to problems. In this paper, the results of the final exam of mathematics class are selected as evaluation indicators. Math test scores can reflect their problem-solving ability and critical thinking level. So as to indirectly evaluate the development of its innovative thinking.

By comparing the passing rate of the final examination of mathematics with that of the undergraduate class without using the teaching system, the development of students'

innovative thinking after using the teaching system for one year is indirectly quantified.

2) COMPETITION WINNING PROPORTION

Competition is usually challenging and competitive, which can stimulate students' innovative motivation. The reasons can be expressed from the following aspects: a) Participating in the competition can encourage students to explore novel fields and accumulate practical experience. Cultivate their innovative thinking and problem-solving ability; b) Competitions are usually conducted in the form of teams. Participating in competitions can improve college students' teamwork ability; c) Participating in competitions can cultivate college students' sense of competition and innovation. In the competition, college students need to constantly try novel ideas and methods to stand out from the competition. This sense of competition and innovation can promote students to play their innovative thinking ability more actively in study and practice; d) Competitions usually involve knowledge and skills in multiple disciplines. Participating in the competition can test the knowledge and skill level of college students. Through the competition results, students can know their knowledge and skills in the corresponding fields. So as to adjust learning strategies and improve learning methods.

This paper selects the increase in the number of students participating in the competition after using the system for one year as an index to evaluate the development of students' innovative thinking. Its rising situation class directly shows the influence of the teaching system on the development of college students' innovative thinking.

3) CLASSROOM ACTIVITY

Classroom activity can be used as a factor to evaluate the development of college students' innovative thinking. It reflects students' participation and thinking ability. Encourage students to actively study and think, and enhance their self-confidence and expressive ability.

The concrete manifestations are as follows: a) The degree of students' participation in classroom discussion and teaching content is directly related to their thinking ability and reaction speed. Students who actively participate in classroom discussions, ask questions, and share ideas usually have higher innovative thinking potential; b) Active classroom atmosphere can encourage students to study and think actively. Encourage them to put forward their own opinions and questions, and communicate and discuss with other students. This active learning and thinking attitude is conducive to cultivating students' innovative thinking; c) In an active classroom atmosphere, knowledge exchange and sharing among students can be promoted. They can share their own opinions, experiences, and opinions, and stimulate the spark of innovative thinking by learning from each other. This process of knowledge exchange and sharing plays a positive role in the development of students' innovative thinking; d) Students can enhance their self-confidence and expressive ability by actively participating in class discussions. They have the opportunity to express their views in front of others and get feedback and suggestions from classmates and teachers. This improvement in self-confidence and expressive ability is also helpful in cultivating students' innovative thinking.

4) STUDENT RECOGNITION

This paper makes a questionnaire survey on the influence of this teaching design platform on the development of college students' innovative thinking. The questionnaire survey contains seven multiple-choice questions to understand students' recognition of this teaching platform. Use descriptive statistics to present the results. Distribute this questionnaire to some students in undergraduate teaching classes. A total of 36 questionnaires were sent out, with 36 valid samples and an effective recovery rate of 100%. Therefore, the results of this questionnaire survey are effective.

IV. RESULTS AND DISCUSSION

A. CLASSICAL DATA SET ANALYSIS

In this paper, the accuracy of single-algorithm and multi-algorithm fusion methods is analyzed by using an Iris data set in a machine learning database [46]. The data set contains 3 kinds of iris, each with 50 samples. Each sample has four attributes: sepal length, sepal width, petal length, and petal width. In this paper, the iris data set is used to analyze the K-means clustering algorithm. Then the K-means clustering and SVM regression algorithm are combined for analysis. Finally, the analysis accuracy of the two methods is compared.

Firstly, the data set is divided into a training set and a test set. Then, the K-means algorithm is used to cluster the training set to get the precision value. Next, the K-means clustering and SVM regression algorithm are combined for clustering analysis and prediction training, and the accuracy of the results is calculated. In this paper, Python is used to realize this process. The accuracy of the K-means clustering algorithm is {k_means_acc:0.753}, and the accuracy of combining K-means clustering and the SVM regression algorithm is {cluster_svm_acc:0.967}.

From the results, it can be seen that the accuracy of the fusion of the K-means clustering analysis and SVM regression algorithm (0.967) is significantly higher than that of the K-means clustering algorithm alone (0.753). This shows that a teaching design that integrates multiple algorithms can provide teaching content with high predict-ion accuracy and high personalization. It can bring intelligent, personalized, and diversified learning experiences to college students.

B. EFFECT EVALUATION OF NOVEL TEACHING DESIGN

This paper evaluates the novel instructional design system from four aspects: the passing rate of the final exam, the proportion of winning prizes in the competition, classroom activity, and students' recognition. Using descriptive statistics, the following results can be obtained graphically:

TABLE 2. Changes in passing rate of mathematics final exam.

Instructional class	Percent of pass	Amplification
Class A	88%	1.173 times
Class B	75%	

TABLE 3. Changes in the proportion of winners in the competition.

Term	Number of participants	Number of winners	Award rate
2021	6	1	16.7%
2022	10	4	40%
Amplification	60%	25%	23.3%

a) Table 1 shows the change in the passing rate of the math final exam using this teaching system. The pass rate of class B without using the teaching system is 75%, and that of class A using the teaching system is 88%. Then the passing rate of the class examination using the novel teaching system is increased by 1.173 times. The statistical results indirectly quantify the development of students' innovative thinking after using the teaching system for one year. It also shows that the novel instructional design system can promote college students' problem-solving ability and critical thinking level.

b) Table 2 and Figure 7 represent the changes in the proportion of winners in competitions using this teaching system. In the semester of 2021, the number of participants in the competition was 6, and the number of winners was 1, with a winning ratio of 16.7%; In the semester of 2022, the number of participants in the competition was 10, and the number of winners is 4, with a winning ratio of 40%. The proportion of winners increased by 23.3%. This shows that college students' knowledge and skill level, innovative thinking level, and teamwork ability have improved significantly.

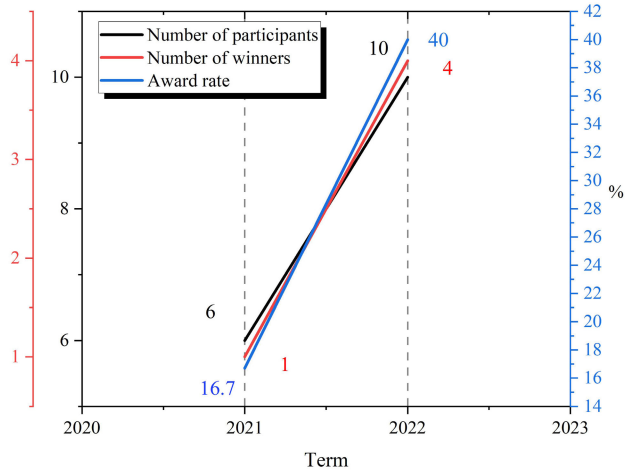

FIGURE 7. Comparison of the proportion of winners.

c) Figure 8 shows the classroom activity feedback from teachers. With 100 as the total score, the following figure shows the score scored by teachers according to the changes of college students in the past year. Compared with the 2021 semester, in the 2022 semester, students actively participated in classroom discussions, asked questions, answered questions, and showed their opinions, and the classroom atmosphere was better. Not only that, it shows a unique and imaginative way of thinking when solving problems and proposing novel ideas. The students interacted and cooperated many times, and showed the results of field trips and case studies after cooperation in class.

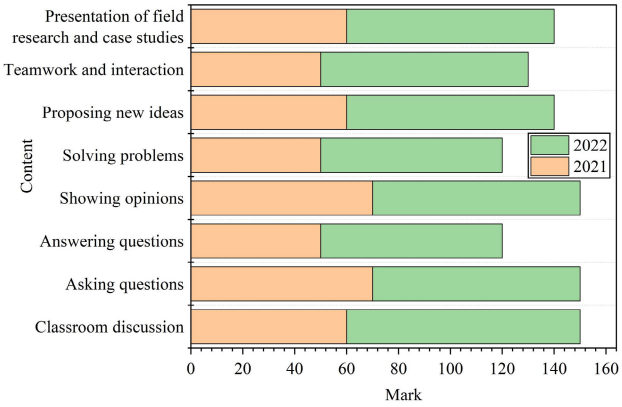

FIGURE 8. Teacher evaluation of classroom activity.

d) Among the 36 questionnaires, as depicted in Table 3, the most frequent response is that the novel teaching system provides personalized learning opportunities, with a frequency as high as 86.1%. Secondly, it provides enough innovative thinking training and resources. Only 5.6% of students said that they would not continue to use the novel teaching system in the future. Generally speaking, the novel teaching system has promoted the development of college students' innovative thinking and has also been recognized by students.

C. COMPARISON BETWEEN NOVEL TEACHING DESIGN AND TRADITIONAL TEACHING DESIGN

The novel teaching system applies advanced modern educational tools, which have achieved many positive effects in teaching effect, improving students' innovative ability, and promoting educational equity. As depicted in Figure 9:

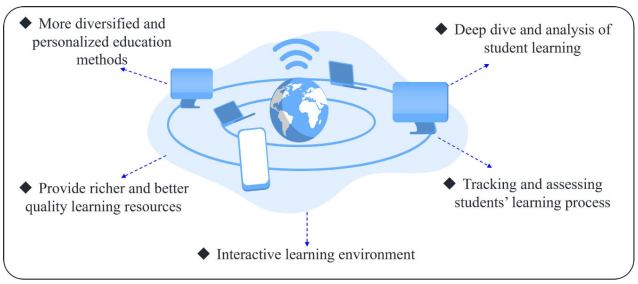

FIGURE 9. Effect of novel network teaching.

TABLE 4. Results of the questionnaire.

Subject content	NO	COMMON	YES
	1	2	3
1. Do you think the teaching system is interesting and challenging?	1	7	28
2. Do you find that your innovation ability has been enhanced when you use the intelligent teaching system?	2	8	26
3. Do you think that the intelligent teaching system provides more learning resources and tools, which helps you to cultivate innovative thinking?	1	6	29
4. Does the intelligent teaching system encourage you to explore and solve problems more actively?	2	6	28
5. Does the intelligent teaching system provide personalized learning opportunities to meet the innovative needs of different students?	1	4	31
6. Do you think the intelligent teaching system provides enough innovative thinking training and resources?	1	5	30
7. Are you willing to continue to use intelligent teaching system to enhance your innovative thinking in the future?	2	4	30

a) This novel network instructional system brings a more personalized learning experience to college students. It can be customized according to student's learning styles, interests, and learning progress. The system can recommend learning resources suitable for students. Different from the teaching system of single-algorithm integration, the teaching design of multi-algorithm integration helps students improve their cognitive and thinking ability at a high level in autonomous learning and interactive learning. This will help to improve the level of creative thinking of university students. It will stimulate their interest and motivation in learning and promote academic growth and personal development.

b) The novel network instructional system can provide richer and better learning resources. Including online video, audio, books, papers, cases, etc. Through cloud computing technology, students can be provided with high-quality educational resources anytime and anywhere, helping them to better complete their learning tasks. The diversity of learning resources can stimulate students' creative thinking. It helps them to think about and solve problems from different perspectives. However, the traditional artificial teaching system is often limited by time space, and material conditions and cannot provide such resources.

c) The novel network instructional system can build an interactive learning environment through the network platform and social tools. It can promote communication and cooperation among students. Enhance students' innovative ability and teamwork abilities. By interacting with others, college students can broaden the breadth and depth of their thinking by seeing things from different perspectives. However, traditional teaching systems often lack such an interactive environment.

d) The novel network instructional system can track and evaluate students' learning process through data analysis. Teachers sum up experience and adjust teaching plans and teaching methods in time. Continuously improve the quality of education and teaching effect. At the same time, the novel network instructional system can establish a good interaction mechanism between teachers and students. To establish a good relationship of trust and communication between students and teachers. It can cultivate students' autonomy and innovation, as well as constantly stimulate students' interest and enthusiasm in learning.

e) The novel network instructional system can deeply explore and analyze students' learning situations. Discover students' potential interests and advantages, and provide a stage for students to explore, practice, and innovate. It can encourage students to think independently exert their creativity, and improve their innovative thinking and ability through teamwork and communication.

Of course, there is room for improvement in this novel networked teaching system. The population used for validation of this system is limited, and the assessment may be biased. It is planned to expand the validation population. Placing this teaching system to the whole program or even college for validation. The amount of data is increased to improve the prediction accuracy of the system. In addition, the experimental population faced science classes and the assessment parameters were set for science majors. Therefore, the generalizability of this instructional system could be improved. Subsequently, it is planned to set multiple assessment indicators, not only limited to science majors.

D. PROMOTION AND APPLICATION OF A NOVEL NETWORK INSTRUCTIONAL SYSTEM

The promotion of novel networked instructional systems is of great significance for educational institutions. It can improve the quality of teaching, personalize learning, adapt to the needs of modern society, and improve the level of innovative thinking among university students. A more flexible, personalized, and efficient way of learning is provided for education [47], [48], [49], [50].

The advantages as well as the importance of the system are publicized through the use of advertisements, brochures, social media, and seminars. At the same time, teachers are provided with training and support on this system. It helps them to master and flexibly use the system to improve the quality and effectiveness of teaching. A technical support channel can be set up to answer the problems teachers encounter in using the system. Next, by establishing partnerships with the government, non-profit organizations, educational associations, and educational institutions. The system can be integrated into their existing platforms. This novel instructional network system can be pilot-tested in one school or a specific program. Feedback from teachers and

students will be collected to make necessary adjustments and improvements to the system.

However, many challenges may be faced in the rollout of the system. Teachers may be skeptical of new technologies. This can be addressed by emphasizing ease of use and positive impact. In terms of privacy, assure the institution that the data will be used responsibly. The privacy and security of student data are ensured and regulations are followed. There is also the need to ensure that the system is compatible with existing teaching platforms. Compatibility issues that may arise are dealt with.

Successful implementation of a novel networked instructional system requires collaboration, training, and ongoing support. Enhancement of teaching practice and the level of innovative thinking of university students by integrating the K-mean clustering algorithm and SVM regression analysis algorithm. Sharing of educational resources as well as increasing equality of educational opportunities through the transformation of educational methods. Ultimately, this will help the country to cultivate talents in line with modernization and development.

V. CONCLUSION

This paper presents the implementation of a novel network instructional design system in a specific undergraduate class. The system integrates the K-means clustering algorithm and SVM regression analysis algorithm, enabling personalized learning customization, integration of diverse algorithms, visual teaching design, and abundant teaching resources. Moreover, it transcends traditional teaching methods and single algorithm design to maximize innovation training for college students.

In this paper, the reliability of our system is verified using classical data sets. The instructional design that integrates multiple algorithms can provide teaching content with high prediction accuracy and a high degree of personalization. It brings intelligent, personalized, and diversified learning experiences to college students. The effectiveness of the system was evaluated by four indicators: the passing rate of the final examination, the proportion of competition winners, classroom activity, as well as student recognition. The results show that the passing rate of the test in the class using the novel teaching system is increased by 1.173 times, the proportion of awards is increased by 23.3%, the classroom atmosphere is significantly improved, and the recognition of students accounts for 86.1%. It shows that the novel instructional design system can promote college students' problem-solving ability, critical thinking level, knowledge and skills level, innovative thinking level, and team cooperation ability.

In general, the novel teaching system plays a role in promoting the development of college students 'innovative thinking and has also been recognized by students. There are several reasons for this: first, the novel network instructional system stimulates students' creativity and thinking vigor by introducing more interactive and practical teaching methods. While traditional teaching methods often focus on knowledge instillation and memorization, the novel system pays more attention to students' active participation and exploration. Second, the novel instructional system utilizes modern technological means to provide rich and diverse learning resources. Including online courses, learning platforms, digital libraries, etc., students can independently choose what and how to learn, stimulating their innovative thinking and desire for knowledge. Third, the novel network instructional system advocates cooperative learning and teamwork. Through group projects and team competitions, students learn from each other and exchange ideas in cooperation. It cultivates their innovative thinking and teamwork ability. At the same time, the novel instructional system adopts diversified evaluation methods. It focuses not only on students' knowledge mastery but also on the development of their innovative thinking and abilities. Students' innovative thinking and abilities are evaluated utilizing project reports and the presentation of innovative works, motivating them to actively participate in innovative activities. In summary, the novel instructional system promotes the development of college students' innovative thinking by emphasizing the cultivation of practical ability, providing diversified learning resources, advocating cooperative learning and independent thinking, as well as innovating evaluation methods.

Although the novel network instruction system proposed in this paper shows great advantages in the actual teaching process, it is not a complete substitute for teaching in reality. The small number of students involved in the experiment affects the accuracy and universality of the system's practice. Therefore, the future research direction of this paper will focus on expanding the number of experimental subjects, improving the prediction accuracy, and increasing the universality of system use. Combining the online teaching pedagogical system with actual teaching aims to explore an appropriate way to promote the overall development of students.

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