ingegneria sismica
International Journal of Earthquake Engineering
Anno XLIII - Num. 1 - 2026

Strategies for Physical and Mental Development and Motor Skill Training for Students under the Framework of Higher Education Physical Education Curriculum Reform

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SUMMARY: *This research integrates data mining techniques into the transformation of university physical education programs, creating and executing a physical education course configuration system based on data mining techniques. This study suggests solutions for transforming university physical education programs, as well as solutions for promoting the physical and mental development and athletic skills of the learners. This study evaluates the success of the course configuration system and solutions suggested above from two angles: learners' physical and mental development and athletic skills acquisition. From the experimental results, it can be seen that there are remarkable differences between the experimental group and the control group, who have comparable pre-experimental conditions. With regard to the physical and mental development results, the scores of the experimental group were 4.99 to 10.89 higher than those of the control group, where all P-values were less than 0.01 and showed statistically significant differences. In terms of athletic skills acquisition, the experimental group obtained scores that exceeded those of the control group by 3.29 to 6.37 points.*

KEYWORDS: *data mining; association rules; physical and mental development; motor skills; physical education curriculum reform*

1 Introduction

Due to the development of society and change in the demands of students, physical education has become increasingly important in higher education institutions. The emergence of a strategy for creating sports excellency, improvement in the laws and regulations on physical education in different regions, as well as physical education at universities, all have changed the positioning of university physical education in today's world [1, 2]. Over the past few years, the physical condition, health, and love for sport activities among students has continued to decline. Not only their success rate in physical fitness tests has been on a steady decrease, but also the number of overweight and obese students has continued to grow [3, 4]. In addition, the number of sick students has increased. These are students not only suffering from some diseases related to the deteriorating state of their physical condition, but also those suffering from mental problems, such as depression, resulting in them being referred to as "fragile college students" [5, 6]. Therefore, in such conditions, the need for curriculum reforms in physical education at universities is crucial for ensuring proper development of physical and mental wellbeing of

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https://doi.org/10.65102/is2026148
Published: 30 April, 2026

students, improving the quality of physical education, and advancing physical education as a whole [7, 8].

In the higher education physical education system, motor skills development is very important to promote healthy growth in students. It helps in the development of physical capabilities, endurance, and perseverance. It also develops cooperation, confidence, problem-solving skills, and decision-making skills among students [9-12]. Moreover, the importance of physical education is no more confined to sports skills training alone but has become an important element for promoting the well-being of students. Physical and psychological well-being can be defined as a holistic process where the individual maintains optimum physical and mental capability with regard to his/her physiological, psychological, and social adjustment process. Well-being is not simply the absence of illness; rather, it aims at improvement in physical fitness and energy levels [13-15].

On the other hand, it entails healthy emotion management, continual cognitive development, and improved social skills—the overall creation of psychological toughness and stress coping skills [16-18]. In students, physical and psychological wellness has significant impact on their individual development, academic success, and future path in life. Physical fitness contributes to efficient acquisition of knowledge and development of stress tolerance; at the same time, good mental health helps students to acquire a positive attitude towards academic and social activities [19, 20]. Both physical and mental wellness development help individuals to develop an increased self-awareness, healthy emotional state, and prepare for future social and professional activity [21, 22]. Therefore, studying the positive influence of physical exercise on students' physical and psychological development and improvement of motor skills, especially in developing new curriculums of physical education, which can contribute to health improvement and physical fitness, becomes an important area of academic study.

This article proposes a curriculum design for the data mining based physical education program and develops its architectural design. Starting from the current state of university physical education courses, it proposes targeted strategies for physical and mental health development and sports skill cultivation in university physical education reform. To investigate the practical feasibility of the proposed reform strategies and curriculum system, a teaching experiment method compares outcomes between an experimental group and a control group. Evaluated dimensions include physical and mental development (sports participation, interest in physical education, independent inquiry, awareness of self-directed exercise, habit retention, and self-assessment) and athletic skill cultivation (strength, speed, agility, endurance, and explosive power).

2 Strategies for Reforming Physical Education Curricula in Higher Education Institutions

2.1 Data Mining-Based Sports Curriculum Design System

2.1.1 Overall Design of the Curriculum System

The course structure system framework is shown in Figure 1. The university data mining application system divides the data mining process into three layers: the data layer, the functional layer, and the representation layer. Control flow proceeds from top to bottom through each layer, while data flow moves from bottom to top. Each layer is supervised by the data mining management process, and the metadata information processed at each level is stored and manipulated by the metadata management unit.

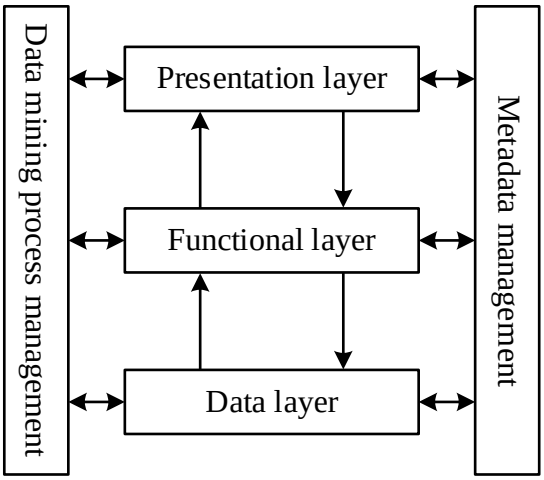

Figure 1: Curriculum Settings system framework

(1) Data Layer

The data layer is considered the building block of the framework. It provides interfaces for accessing data by the algorithm layer, describing data to the process management layer, and transforming data from raw to thematic and metadata. Externally, it offers interfaces for data preprocessing functions including transformation, cleansing, loading, and scheduling.

(2) Functional Layer

The functional layer is the most critical component, primarily responsible for selecting appropriate mining algorithms to analyze data and derive genuinely meaningful knowledge. It issues data access commands to the data layer, provides algorithm configuration descriptions for the data mining process, and supplies metadata management with all metadata information relevant to the algorithm layer.

(3) Presentation Layer

Mined patterns are represented through visualizations or reports. This layer serves decision-makers and the GUI (Graphical User Interface) of the data mining application platform.

(4) Data Mining Process Management

Manages the entire data mining process, enabling the recovery or modification of subtasks at any stage of the process.

(5) Metadata Management

SQL Server 2000 Metadata Services stores a model that maps data structures within databases and data warehouses. This information primarily supports rapid development tools from third parties, which can either build application prototypes or provide application templates based on information within the model.

2.1.2 Architecture of the Course Data Mining Application System

Following the data mining application system framework outlined above, which categorizes data mining into distinct levels, we have designed the curriculum data mining application system architecture as shown in Figure 2.

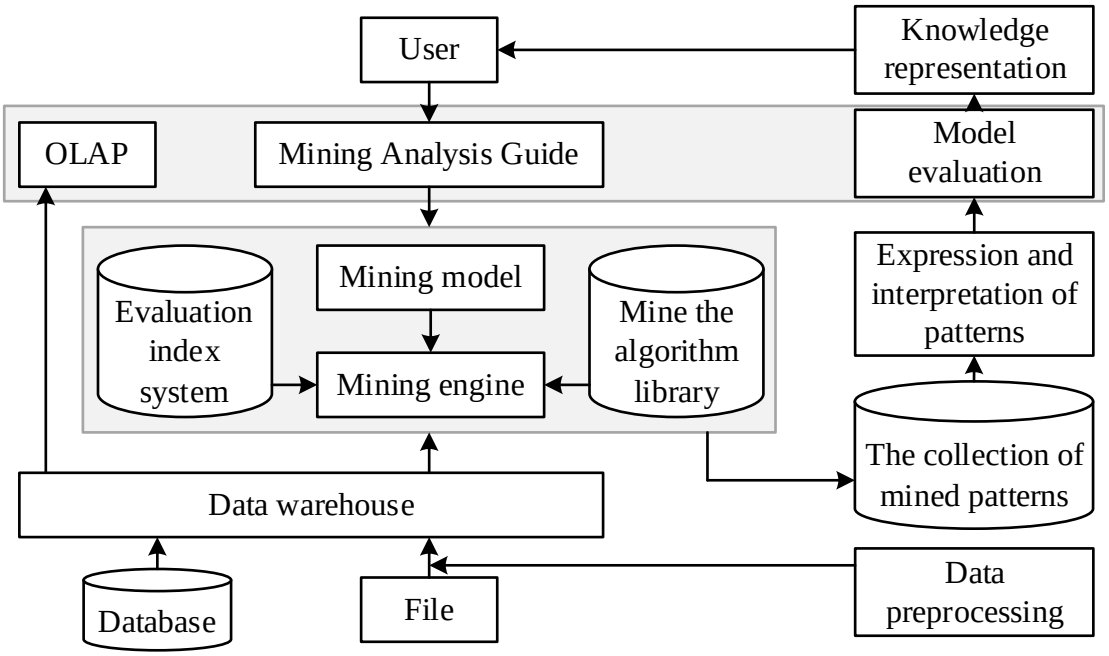

Figure 2: The course setting data mining system structure

(1) Data Layer

By collecting and organizing data from school data sources through preprocessing, a data warehouse is established. Utilizing the data warehouse enables both direct development of advanced information management methods and provision of data support for data mining. The establishment of the data warehouse provides effective data support for subsequent applications.

(2) Functional Layer

The functional layer constitutes the core component of the data mining system. This framework includes various technologies such as data mining and machine learning, and it mainly uses data mining techniques to extract knowledge from the data warehouse.

Presentation Layer

The presentation layer provides visualization of the data mining output in a format understandable by humans, which helps analyze the information. The data mining output can be presented in different forms, such as natural language, graphics, and tables [23].

2.2 Strategies for Physical and Mental Health Development in Physical Education Curriculum Reform

(1) Use pre-class surveys and assessment to find out the mental level of health of students.

Physical education classes are important classes in which students can take overall physical training and adjust their psychological conditions. Physical educators have to improve their teaching focus about physical education lessons. Physical education programs have to aim accurately to the developmental level of the physical condition of students and also the psychological level changes that students have experienced. Hence, physical educators have to undertake pre-class researches to know the present level of stress that individual student experiences because of academic studies, work pressures and others, along with the way he/she likes to relieve stress during the physical education class. After getting an insight into the mental health of students, physical education educators have to be able to change their plans accordingly.

(2) Respect for Students' Active Position and Psychological Change Monitoring During Physical Education Classes

Due to the growing trend towards quality education, it is important for teachers to move from teacher-oriented educational philosophies. Physical education classes especially have to respect students' active position and offer individualized learning services. Firstly, in the case of students choosing semester activities, the teachers need to communicate extensively in order to learn about the real desires of students. Every activity must be presented comprehensively so that they can pick sports according to their taste. Secondly, prior to physical exercise, teachers will organize warm-up exercises taking into account students' physical abilities. Thus, weaker students do not have problems participating in the exercise without getting hurt, while stronger students would not be frustrated by the class being easy. Finally, it is essential for the PE teachers to use conversations with students and observe their behavior in classroom activities to find out what problems students may encounter during this stage of their studies.

(3) Diversify Physical Education Programs and Prioritize Emotional Connection in Instruction

Apart from conventional ball games, track & field sports, and gymnastic exercises, the teachers can use modern sports competition activities or character training programs to increase the learning experience of the lesson and thus generate interest and enthusiasm among the students. In addition, during the teaching of subjects, physical education teachers should focus a lot on the communication of emotion with students. Efficient and proper communication helps in increasing the status of the teacher in the eyes of students and increases the charm of the teacher so that the students enjoy physical education classes.

(4) Post-class follow-up to safeguard students' mental health

While physical activity in PE classes helps reduce psychological stress for some time, teachers need to keep themselves close to the students even after class so that any psychological change among them can be monitored. Establishing a relationship by becoming friendly with the students motivates them to report any problems or pressure right away. Moreover, teachers of physical education should coordinate with school counselors as well. On the basis of the replies given by the students in the survey and classroom behavior, discuss the psychological condition of the students with the counselor. If necessary, call for the counselor’s help to guide the students psychologically in a friendly manner during future PE classes.

2.3 Strategies for Cultivating Physical Skills in Physical Education Curriculum Reform

(1) Building a Rational Model for Physical Education Instruction and Assessment

Various models of physical education instruction do not have a unified core concept and philosophy, which makes it impossible for these models to foster physical literacy in all university students. In fostering physical literacy in university students, there should be an approach centered around three aspects, namely, “Knowledge-Belief-Action.” It is necessary for the students to obtain knowledge of physical skills and their principles and theories first. Subsequently, they should be able to develop their physical skills, feel confident about their abilities and incorporate physical activities into their daily routines to achieve healthy physical fitness. These three aspects interlink and progress in stages. Universities should build a coherent physical education model that considers these three aspects and caters to varied topics. Moreover, during the implementation of such courses, priority should be given to the physical well-being of the students. An assessment system needs to be established in terms of evaluating students’ experiences in physical education classes and checking their physical literacy after the classes.

(2) Developing More Diverse Motor Skills Courses

In current physical education programs for universities, there is a focus on teaching students traditional ball games, such as basketball, football, and badminton, or tranquilizing activities,

such as yoga, ballroom dancing, and aerobics. Students can only learn these actions mechanically without developing their athletic abilities. Besides, the course itself is not systematic, and thus it cannot contribute to the enhancement of students' athletic abilities.

The development of motor skills is an indispensable process that calls for a complete systematic design, which consists of three phases of motor skills cultivation: formation, maturation, and application. In the initial phase of formation, students should not limit themselves to a particular sport activity; rather, students will explore a diversity of sports activities to identify similar training principles among various sports to form essential skills. Students will reach the second phase of maturation once they have acquired essential skills and further developed some advanced skills in addition to acquiring specialized skills in certain sports activities, such as dribbling during running and jumping or throwing during mid-air motion. At this transitional phase, students can master their motions and perform various sports activities. In the third phase, they will become fully accomplished in performing motor skills and adapting their movements to various physical activities.

Thus, universities should first focus on providing standardized training programs of motor skills, after which they may offer diversified sports activities for students who have already acquired proficient motor skills. Through this process, students can freely choose any sports according to their individual interests.

3 Effects on Physical and Mental Development and Motor Skill Cultivation

The effects of the new high-efficiency PE curriculum reform approach on the physical and psychological development of students, as well as their motor skills, were evaluated by using the selected 100 students from a particular study major within School S. Two groups of participants (one experimental and one control) were formed by random assignment, and their physical and psychological development and motor skills were tested before and after the intervention. The efficiency of the chosen strategy was confirmed via independent samples t-tests, among other procedures.

3.1 Physical and Mental Development Outcomes

Six aspects of development of the experimental and control groups were studied by the author: involvement in sports activities, interest in physical education, independent research activity, understanding of the self-directed physical exercises, habit formation, and self-assessment. Before conducting the experiment, in order to make sure that both groups had similar physical and psychological development, assessment was made. The results showed no significant differences in the level of development between the experimental and control groups prior to the beginning of the experiment, thus proving their homogeneousness. Therefore, it was possible to conduct an experiment involving both groups.

Following the completion of the experiment, the physical and psychological development of 100 people from each group was once again evaluated. Independent samples t-tests and differences were calculated for the results gained as illustrated in Table 1 below. As depicted in Table 1, the differences between the experimental and control groups regarding all indicators after the experiment varied from 4.99 to 10.89 points, and the advantage of the experimental group was seen in all parameters. The biggest difference was seen with regard to the involvement in sports, whereas the smallest one was noted in relation to independent research. Statistically significant differences ($P < 0.01$) were discovered for all six indicators analyzed: participation in sports, interest in PE, independent research, awareness about self-guided

exercises, habit maintenance, and self-assessment.

Table 1: Physical and mental development analysis of 2 groups after the experiment

	Experimental group	Control group	Difference	T	P
Sports participation	36.45±4.26	25.56±3.68	10.89	6.452	0.000
Sports interest	34.06±4.67	24.68±3.59	9.38	5.846	0.000
Autonomous inquiry	23.46±4.16	18.47±4.06	4.99	2.948	0.003
Self-exercise awareness	25.62±5.09	15.76±3.15	9.86	6.012	0.000
Habit retention	24.37±3.14	18.08±2.84	6.29	3.846	0.001
Self-evaluation	23.62±3.76	16.74±3.64	6.88	4.062	0.001

Following the teaching experiment of physical education curriculum reform, an analysis was conducted on the experimental group's scores for sports participation, interest in physical education, independent inquiry, awareness of self-directed exercise, habit retention, and self-evaluation before and after the experiment. The exact results are presented in Table 2.

As can be seen from Table 2, after the experiment of teaching was conducted, t-test and calculations of differences were made in regard to six aspects for the experimental group: sports activities, interest in physical education, independent search, self-directed exercising, habit maintenance, and self-assessment. The changes have been made in all six aspects listed above.

Comparing the physical and mental development outcomes of the experimental group before and after the experiment, the P-values for all dimensions were <0.01, indicating highly significant differences. Moreover, the differences between pre- and post-experiment scores were substantial, reflecting notable progress. Among all indicators, the greatest improvement was observed in sports participation, while the smallest improvement was seen in self-directed inquiry.

Table 2: Physical and mental development analysis of experimental group

	Before	After	Difference	T	P
Sports participation	25.42±3.85	36.45±4.26	-11.03	-8.795	0.000
Sports interest	23.84±3.62	34.06±4.67	-10.22	-8.252	0.000
Autonomous inquiry	15.63±2.74	23.46±4.16	-7.83	-5.463	0.000
Self-exercise awareness	12.51±2.83	25.62±5.09	-13.11	-10.595	0.000
Habit retention	14.74±1.99	24.37±3.14	-9.63	-9.045	0.000
Self-evaluation	13.65±2.15	23.62±3.76	-9.97	-9.824	0.000

The same assessment method was applied to the control group. The comparison of physical and mental development outcomes before and after the experiment is shown in Table 3. As indicated in Table 3, the difference in scores across all dimensions of physical and mental development outcomes between pre- and post-experiment for the control group did not exceed 4 points. Furthermore, the significance P-values for each dimension were all greater than 0.05. This demonstrates that the physical and mental development outcomes of the control group students were unsatisfactory, with no significant progress achieved.

Table 3: Physical and mental development analysis of control group

	Before	After	Difference	T	P
Sports participation	26.05±3.54	25.56±3.68	0.49	0.426	0.522
Sports interest	23.41±4.02	24.68±3.59	-1.27	0.824	0.471
Autonomous inquiry	16.42±2.94	18.47±4.06	-2.05	0.901	0.358
Self-exercise awareness	12.67±3.02	15.76±3.15	-3.09	0.924	0.632
Habit retention	14.23±2.31	18.08±2.84	-3.85	1.065	0.586
Self-evaluation	13.11±2.57	16.74±3.64	-3.63	0.986	0.479

3.2 Development of Motor Skills

Regarding the effectiveness of developing students' motor skills, this paper will evaluate outcomes across five dimensions: strength, speed, agility, endurance, and power. Similarly, motor skill tests were administered to both the experimental and control groups prior to the experiment. The test data revealed that pre-experiment scores for strength, speed, agility, endurance, and power were comparable between the two groups, with no statistically significant differences observed (all P-values > 0.05). This means that the pre-experimental distribution of motor skill among the experimental and control groups was adequate, fulfilling all conditions required before conducting further experimentation.

The motor skill measurement outcomes of both the experimental and control groups were later compared after conducting the experiment. An independent samples t-test was performed in order to determine whether there were any significant differences between the two groups. This is depicted by Figure 3. Analyzing the findings depicted in Figure 3, it is evident that the experimental group performed better than the control group on all five motor skill development measurement criteria.

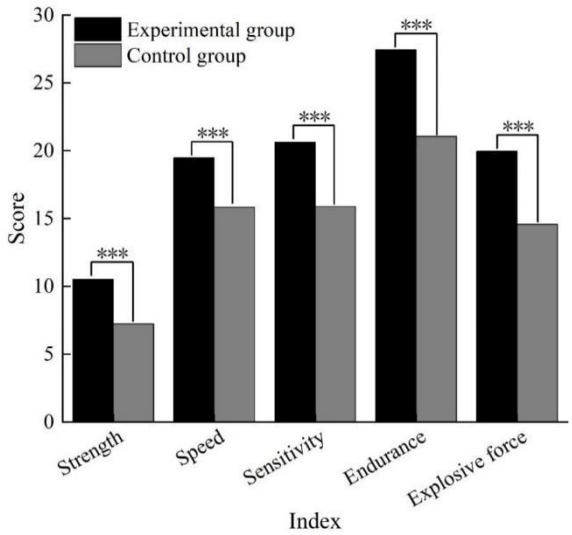

Figure 3: Athletic skill analysis of 2 groups after the experiment

Regarding the comparison of the results of motor skill test scores of the experimental group in both pretest and post-test phases, the obtained results have been presented in Figure 4. According to Figure 4, after being subjected to the experiment regarding the implementation of the university physical education curriculum reform, it can be seen that the experimental group was able to show improvement in terms of strength, speed, agility, endurance, and explosive power. Out of all five variables, endurance scored the highest gain of 6.78 points, while strength had the lowest gain of 3.94 points. In addition, there is a considerable difference between pre-

experiment and post-experiment in terms of development of students' athletic skills.

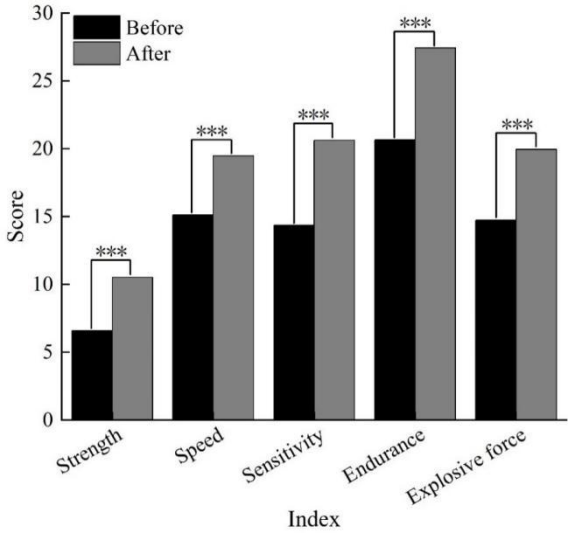

Figure 4: Athletic skill analysis of experimental group

Likewise, Figure 5 demonstrates the analysis results of comparing the development status of motor skills in the control group before and after the intervention. As can be seen from Figure 5, there were no remarkable differences found among five dimensions including strength, speed, agility, endurance, and power between the two periods. This means that the development status of motor skills of the control group is ineffective.

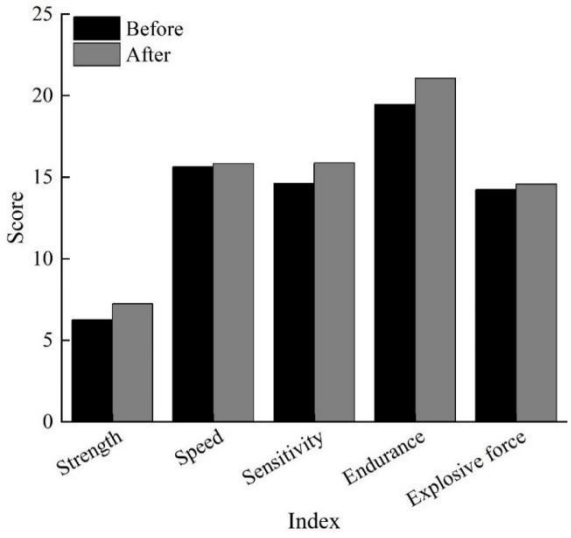

Figure 5: Athletic skill analysis of control group

4 Conclusion

In this paper, we apply data mining techniques to design a university physical education teaching course system and formulate methods to promote physical and mental health development and athletic skills Subsequently, the effectiveness of the proposed university physical education curriculum reform strategies is evaluated through teaching experiments.

Prior to the experiment, no significant differences were observed between the experimental

and control groups in terms of physical and mental development indicators or athletic skill cultivation metrics, with all P-values exceeding 0.05. Post-experiment, the experimental group significantly outperformed the control group across all physical and mental development outcomes and athletic skill cultivation measures, demonstrating statistically significant differences. Meanwhile, the control group showed no significant improvement in physical/mental development or athletic skills before and after the experiment, whereas the experimental group achieved significant enhancements with P-values below 0.01 for all indicators. This study confirms that the proposed university physical education curriculum reform strategy exerts a markedly positive impact on students' physical and mental development and athletic skill cultivation.

Funding

This work was supported by Ministry of Education's Employment-Education Project for Supply and Demand Connection: "University Human Resource Management in the Research on Children's Psychological Resilience under the Background of School-Enterprise Cooperation" (Project No: 2024121797142);

This work was supported by Anhui Provincial Quality Engineering General Teaching Research Project: "Research on the Reform of Employment Guidance Curriculum System in Higher Vocational Colleges Based on the Improvement of Professional Literacy" (Project No: 2024jyxm1203).

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