Empirical Research on Credit System Management for Chinese Vocational College Students Based on Personal Mobile Terminals

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Abstract: Managing credit evaluations within the context of Chinese vocational college students presents unique challenges due to uncertainties and individual financial circumstances. This paper introduces a novel approach, the Fuzzy Firefly Optimization Classification (FFOC) Credit System, which combines fuzzy logic and the firefly optimization algorithm to revolutionize credit assessment. Fuzzy logic accommodates uncertainty by assigning degrees of membership to linguistic variables, while the firefly optimization algorithm fine-tunes credit evaluation parameters through an iterative optimization process. In this system, linguistic variables such as "Income" and "Credit Score" are employed to establish fuzzy rules that capture the nuances of creditworthiness. The firefly optimization algorithm enhances these rules, adjusting them over iterations to better match real-time data and fitness evaluations. This results in accurate and personalized credit score assignments, empowering vocational college students with tailored financial assessments. The FFOC Credit System's significance lies in its ability to foster responsible financial behaviors among students while providing fair and precise credit evaluations. With addressing uncertainties and adapting to changing financial dynamics, this system offers a dynamic solution that promotes financial literacy and stability. As vocational college students transition into the workforce, the FFOC Credit System equips them with the tools they need to make informed financial decisions, ensuring a brighter financial future. In conclusion, the Fuzzy Firefly Optimization Classification Credit System presents an innovative methodology that combines fuzzy logic and optimization algorithms to redefine credit assessment. The results stated that accuracy, and personalization make it a powerful tool for managing credit evaluations for Chinese vocational college students, bridging the gap between financial education and responsible financial behavior.

Keywords: Credit Management System, Mobile Terminus, Fuzzy Logic, Firefly Optimization, Vocational Students

1. Introduction

Credit system management is a crucial component of modern financial institutions and lending practices [1]. It involves the systematic management, evaluation, and monitoring of individuals' or entities' creditworthiness and financial behavior. Through this process, lenders assess the potential risk associated with extending credit to borrowers, making informed decisions about granting loans, credit cards, or other forms of credit [2]. Credit system management relies on sophisticated algorithms, historical data analysis, and a comprehensive understanding of economic trends to assign credit scores and determine interest rates [3]. Effective credit system management not only enables financial institutions to minimize risks and losses but also empowers individuals to access the credit they need to achieve their financial goals while maintaining responsible financial behaviors [4]. Credit system management plays a pivotal role in shaping the modern financial landscape, influencing lending practices, economic growth, and individual financial well-being. This multifaceted process involves several key components that collectively determine an individual's creditworthiness and guide lending decisions

[5]. One of the core aspects of credit system management is credit scoring. Lenders use complex algorithms to analyze various factors, such as payment history, credit utilization, length of credit history, types of credit accounts, and recent credit inquiries, to assign a numerical value known as a credit score [6]. This score serves as a quick snapshot of an individual's credit risk, allowing lenders to make swift and informed decisions about extending credit. A higher credit score typically indicates lower risk and can lead to more favorable terms, such as lower interest rates and higher credit limits. Furthermore, credit system management involves the continuous monitoring of borrowers' financial behaviors [7]. Lenders track changes in credit utilization, payment patterns, and other relevant indicators to assess whether a borrower's credit risk has changed over time [8]. This ongoing evaluation enables lenders to identify potential problems early on and take appropriate actions, such as adjusting credit limits or offering financial advice.

The credit system is closely intertwined with economic trends and regulatory frameworks. Institutions engaged in credit system management must stay attuned to market dynamics, interest rate fluctuations, and shifts in consumer behavior [9]. Additionally, adherence to legal and ethical guidelines is crucial. Regulatory bodies impose standards to ensure fair lending practices and

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protect consumers from discrimination or exploitative lending. Effective credit system management benefits both lenders and borrowers [10]. For lenders, it minimizes the risk of defaults and bad debts, contributing to the stability and profitability of financial institutions. For borrowers, a well-managed credit system enables access to credit, which is essential for making significant purchases like homes or cars, pursuing education, and managing unforeseen expenses [11]. Moreover, credit system management supports financial literacy and responsibility. Through assessing creditworthiness based on financial behaviors, the system incentivizes responsible borrowing and timely repayment. This encourages individuals to make informed financial decisions, cultivate healthy financial habits, and ultimately improve their long-term financial prospects [12]. The integration of a credit management system with mobile terminals has revolutionized the way financial transactions and credit interactions take place. This innovative convergence combines the convenience and ubiquity of mobile technology with the efficiency of credit management, creating a seamless and accessible experience for both lenders and borrowers [13].

With credit management systems integrated into mobile terminals, borrowers can conveniently apply for credit, monitor their credit scores, and access their financial history on-the-go [14]. The mobile interface provides real-time updates on credit utilization, payment statuses, and other relevant information, empowering users to make informed financial decisions right from their smartphones or tablets [15]. This accessibility fosters financial literacy as individuals can track their credit health and learn how to improve it through instant access to personalized insights. For lenders, mobile terminals facilitate faster and more efficient credit evaluation processes [16]. They can assess credit applications remotely, leveraging digital documents and real-time data to make quicker decisions. Additionally, mobile terminals enable lenders to interact with borrowers in real time, providing instant responses to inquiries, offering customized credit options, and even disbursing funds directly to mobile wallets [17]. Security remains a paramount concern in credit management systems with mobile terminals. Advanced encryption, biometric authentication, and multi-factor verification protocols help ensure the privacy and integrity of sensitive financial information, building trust between users and the system [18]. The integration of credit management systems with mobile terminals represents a significant leap forward in the realm of financial technology [19]. This synergy empowers borrowers with unprecedented accessibility, transparency, and financial literacy while allowing lenders to streamline their processes and provide enhanced services [20]. As this integration continues to evolve, it has the potential to reshape the landscape of credit management and redefine how individuals and institutions interact within the financial ecosystem [21].

This paper focused on the development of the appropriate scheme for the credit management system in the personal mobile terminals. The primary contribution lies in the introduction of the Fuzzy Firefly Optimization Classification (FFOC) Credit System, a novel approach that combines the power of fuzzy logic with the precision of the firefly optimization algorithm. With integrating these methodologies, the paper addresses the inherent uncertainties in credit evaluation and offers a more accurate and personalized credit assessment process. One significant outcome of the FFOC Credit System is its ability to provide personalized credit assessments for vocational college students. Through the use of linguistic variables and fuzzy rules, the system tailors credit evaluations to each student's unique financial situation. This personalized approach contributes to fairer and more accurate credit score assignments, fostering responsible financial behaviors and encouraging financial literacy among students. An important aspect of the paper's contribution is the dynamic nature of the FFOC Credit System. The incorporation of the firefly optimization algorithm enhances the credit assessment process by iteratively optimizing fuzzy rules based on real-time data and fitness evaluations. This adaptability ensures that the system can effectively respond to changing financial dynamics, resulting in credit classifications that reflect current financial circumstances. Additionally, this paper's focus on empowering vocational college students is significant. With providing students with insights into their creditworthiness and encouraging responsible credit management, the FFOC Credit System equips them with valuable skills for their financial futures. This contribution extends beyond academia, potentially influencing credit assessment practices in real-world financial institutions and agencies. The paper's contributions encompass the innovative integration of fuzzy logic and the firefly optimization algorithm, leading to a personalized, accurate, and adaptable credit assessment process. The emphasis on financial literacy and empowerment of vocational college students highlights the system's practical relevance and potential for shaping responsible financial behaviors among the next generation of professionals.

2. Fuzzy Firefly Optimization Classification (FFOC) Credit System

The Fuzzy Firefly Optimization Classification (FFOC) Credit System represents a cutting-edge approach to credit system management tailored for Chinese vocational college students. This innovative system leverages the power of fuzzy logic and firefly optimization algorithms to create a comprehensive and personalized credit

evaluation process, all accessible through students' personal mobile terminals. FFOC combines the flexibility of fuzzy logic with the efficiency of firefly optimization to assess creditworthiness. The fuzzy logic framework accommodates the inherent uncertainties associated with credit evaluation, considering not only traditional credit parameters but also additional socio-economic factors specific to vocational college students. The firefly optimization algorithm fine-tunes the classification process, optimizing the credit evaluation model over time based on real-time data. The integration of personal mobile terminals enhances accessibility and engagement for students. They can conveniently access their credit profiles, monitor changes, and receive real-time updates on their credit standing directly from their smartphones. Additionally, the mobile interface serves as a portal for credit education resources, empowering students to understand the nuances of credit management and make informed financial decisions. The FFOC Credit System addresses the unique needs of Chinese vocational college students, recognizing their transitional phase from education to the workforce. It helps students build positive credit histories by offering tailored credit options and recommendations, ultimately contributing to their financial stability and future opportunities. This system not only fosters financial literacy but also instills responsible credit behavior from an early stage, promoting a culture of financial awareness and prudence. The Fuzzy Firefly Optimization Classification (FFOC) Credit System for Chinese vocational college students is a sophisticated approach that combines fuzzy logic and firefly optimization algorithms to create a robust credit evaluation model. This model is specifically designed to assess the creditworthiness of students, considering both traditional credit parameters and additional socio-economic factors. Fuzzy logic accommodates the uncertainties present in credit evaluation by assigning degrees of membership to various credit-related parameters. A student's "Income" as a parameter. Instead of a binary classification (Good or Bad), fuzzy logic assigns a degree of membership to different classes. Let's define three classes: Low, Medium, and High.

μLow(Income): Degree of membership to the Low income class.

μMedium(Income): Degree of membership to the Medium income class.

μHigh(Income): Degree of membership to the High income class.

The fuzzy logic rules can be defined using linguistic variables like "Income" and "Credit Score":

Rule 1: IF Income is Low THEN Credit Score is Low.

Rule 2: IF Income is Medium THEN Credit Score is Medium.

Rule 3: IF Income is High THEN Credit Score is High.

These rules determine how the student's income level affects their credit score. The final credit score can be calculated using a weighted average of the membership degrees from these rules. Fuzzy logic is employed to handle the uncertainty and imprecision in credit evaluation. It allows for a more nuanced assessment of creditworthiness by considering multiple factors. Let's denote the input variables for the fuzzy logic component as:

X1: Payment History

X2: Credit Utilization

X3: Length of Credit History

X4: Types of Credit Accounts

X5: Recent Credit Inquiries

The membership functions for each input variable are defined using fuzzy sets. For instance, let's consider the membership function for Payment History (X1):

Poor (P): $\mu P(x)$ = Triangular(x, 0, 50, 70)

Fair (F): $\mu F(x)$ = Trapezoidal(x, 50, 70, 80, 90)

Good (G): $\mu G(x)$ = Triangular(x, 80, 90, 100)

Firefly optimization is used to fine-tune the fuzzy logic classification process. It seeks to optimize the credit evaluation model by adjusting the parameters of the membership functions. Let's denote the optimization parameter as α and define the firefly intensity as I.

The attractiveness of a firefly (Attractiveness) toward another firefly is calculated using the following equation (1):

$$Attractiveness = \beta * \exp(-\gamma * distance^2)$$
$$(1)$$

Where β represents the attractiveness scaling factor and γ represents the light absorption coefficient. The movement of a firefly toward another firefly is determined using equation (2)

$$New\ Position = Current\ Position + Attractiveness * (Position\ of\ Other\ Firefly - Current\ Position) + \alpha * (random\ number\ between\ 0\ and\ 1)$$
$$(2)$$

Credit Evaluation and Classification: After the fuzzy logic membership functions are adjusted using firefly optimization, the credit evaluation process involves aggregating the fuzzy outputs and making a classification decision. Let's denote the aggregated fuzzy output as Z

and the credit classification as C computed using equation (3)

$$Z = w1 * X1 + w2 * X2 + w3 * X3 + w4 * X4 + w5 * X5 \qquad (3)$$

Where wi represents the weight associated with each input variable. The credit classification can be determined based on the aggregated fuzzy output using rules, Mamdani to define the decision boundaries and outcomes.

Table 1: Mamdani Rule fo the FFOC

Rule Number	Fuzzy Logic Rule	Credit Score Fuzzy Set
Rule 1	IF Income is Low THEN Credit Score is Low	μLow(Credit Score)
Rule 2	IF Income is Medium THEN Credit Score is Medium	μMedium(Credit Score)
Rule 3	IF Income is High THEN Credit Score is High	μHigh(Credit Score)

The combination of fuzzy rules and the firefly optimization algorithm within the FFOC Credit System results in a dynamic credit evaluation process. Fuzzy logic accommodates uncertainty through linguistic variables and membership functions, while the firefly optimization algorithm refines these rules over time for better accuracy. This integration ultimately provides more precise and tailored credit evaluations that cater to the unique circumstances of Chinese vocational college students.

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Algorithm 1: Personal Credit Mangement System for the FFOC

# Parameters for FFOC

population_size = 50

max_iterations = 100

beta = 1.0  # Attractiveness scaling factor

gamma = 1.0  # Absorption coefficient

# Initialize fireflies

initialize_fireflies(population_size)

for iteration in range(max_iterations):

    for i in range(population_size):

        for j in range(population_size):

            if fitness(i) < fitness(j):

                # Calculate attractiveness

                attractiveness = beta * exp(-gamma * distance(i, j) ** 2)

                # Move firefly towards brighter one

                move_firefly(i, j, attractiveness)

        # Update fuzzy rules using firefly positions

    update_fuzzy_rules()

    # Evaluate credit scores using updated fuzzy rules

evaluate_credit_scores()
```

In the algorithm, population_size: Number of fireflies in the population; max_iterations: Maximum number of optimization iterations; beta and gamma: Parameters controlling the movement of fireflies.

The main steps are as follows:

- Initialize fireflies: Generate a population of fireflies, each representing a potential solution.
- Iterate over optimization:
- For each firefly (i), compare its fitness with other fireflies (j) and calculate their attractiveness based on fitness and distance.
- Move the firefly towards a brighter one using the attractiveness formula.
- Update fuzzy rules: Use the firefly positions and their attractiveness values to adjust the parameters of fuzzy rules, optimizing them for better credit classification.
- Evaluate credit scores: After optimization, use the updated fuzzy rules to evaluate credit scores for students based on their income and other relevant parameters.

3. Data Collection for the FFOC

The data used in this paper is obtained by the author through the investigation of the credit system management personnel or departments of the above four higher vocational colleges. The data are mainly collected by means of network email and online questionnaire filling. The samples basically cover the students and credit system management related units and personnel of the four higher vocational colleges within the scope of the study. In order to obtain the data needed for the research, designed the Questionnaire on the Management of the Credit System of Vocational College Students' Personal Mobile Terminal and the Questionnaire on the Management of the Credit System of Vocational College Administrators. The two questionnaires have a total of 26 investigation items, and to select one in each of the four provinces with relatively concentrated vocational colleges. Among them, 500 questionnaires were randomly distributed among students of four higher vocational education colleges in Jiangsu (referred to as A school), Shandong (referred to as B school), Guangdong (referred to as C school) and Zhejiang (referred to as D school), and 240 questionnaires were distributed by credit system management personnel or departments.

Table 2: Basic situation of four higher vocational colleges

School name	Total school population	teachers number	Number of students	Teacher-student ratio	Number of subjects covered	Are there enough classrooms?	Whether there is a LAN	Implementation system
A Higher vocational college	16634	805	15829	19.7:1	7	yes	yes	The academic year credit system
B Higher vocational college	11453	478	10680	22.3:1	11	yes	yes	The academic year credit system
C Higher vocational college	12763	434	12200	28.1:1	5	no	yes	The academic year credit system
D Higher vocational college	13842	551	13291	24.1:1	7	no	no	The academic year credit system

Source: This study collated

In this study, Cronbach'sα method was mainly used to test the reliability of the questionnaire as given in table 2. When Cronbach'sα was greater than 0.9, the reliability of the questionnaire was fully accepted. When 0.7 is greater than Cronbach'sα is less than 0.9, the reliability level of the scale is medium. When 0.6 is greater than Cronbach'sα is less than 0.7, it indicates that the reliability of the scale is within the reliability range. If the reliability coefficient of the scale is less than 0.6, it indicates that the trust of the scale is at a low level. The reliability coefficient analysis results of this study are as follows:

Table 3: Reliability analysis

Latent variable	Number of measurement items	Cronbach'sα	totality Cronbach'sα
result	3	0.859	0.939
Curriculum management	3	0.925	
Department management	3	0.913	
Update management	2	0.868	

It can be seen from the above table 3 that the Cronbach's Alpha coefficient of all latent variables is above 0.7, and the Cronbach's Alpha coefficient of the whole is 0.939, indicating that all variables of the questionnaire have good internal consistency. It shows that the reliability of the measurement scale in this study is in line with the empirical requirements, which provides a strong guarantee for the validity of the subsequent research results in this paper. In this study, principal component analysis was used to examine the variance contribution of the first principal component. The greater the contribution rate of the factor, the greater the importance of the questionnaire design question to the potential variable, and it is generally believed that more than 50% is better.

Table 4: Variance of principal component

Latent variable	Variance contribution rate
result	78.290
Curriculum management	87.256
Department management	85.216
Update management	88.371

It can be found from the above table 4 that the contribution of each measured variable to the latent variable is more than 50%, which indicates that the structural validity of each variable in this study is good and meets the requirements of empirical analysis. Analysis of the current situation of credit system management in China's higher vocational colleges based on personal mobile terminals.

4. Result Analysis

In terms of students' personal information, it mainly investigates the gender, grade and major of students. In terms of gender, 40.4% of the students are male and 59.6% are female, with an appropriate ratio of male to female, which is generally consistent with the current male-female ratio in our school. In terms of the grade of the student, the vocational school system is generally 3 years, of which the proportion of first-year students is 33%, the proportion of second-year students is 28% and the proportion of third-year students is 39%. In terms of students' majors, this survey covers 6 majors, and the proportion of students surveyed in each major is shown in Figure 1 below.
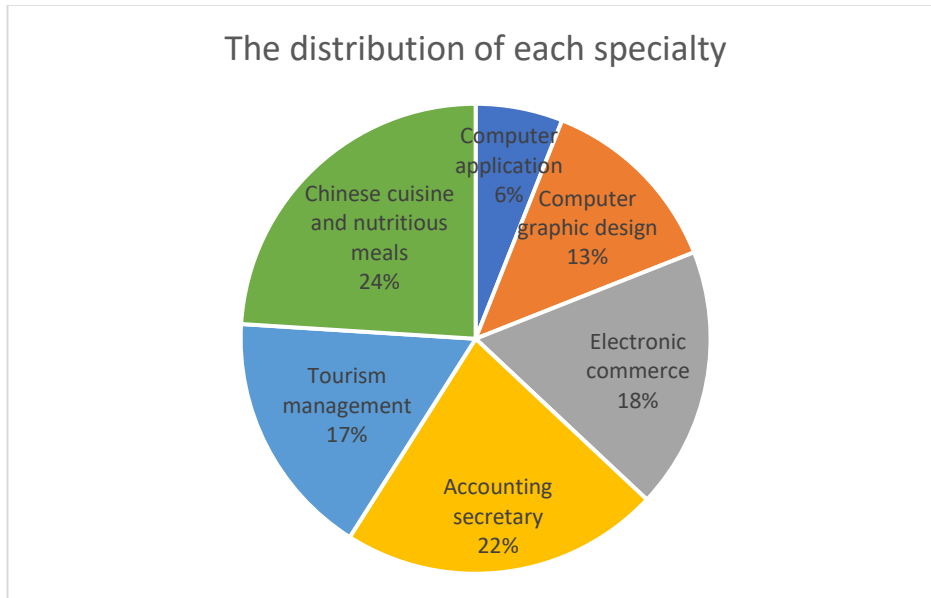
Fig 1: Distribution of each specialty

Due to the unsatisfactory teaching management software and the participation of students' mobile terminals in the management of the credit system in higher vocational colleges, the difficulty of teaching work has increased. When analyzing the questionnaire on the management of the credit system in higher vocational colleges, it is found that the difficulty of both student management and teaching management has increased, as shown in Table 3 and Table 4:

Table 5: Difficulty analysis of student management work

After the implementation of the credit system, the difficulty of students' management work	percent
Increase a lot	16%
Have increased	55.7%
Same as before	28.3%

Table 6: Difficulty of teaching management

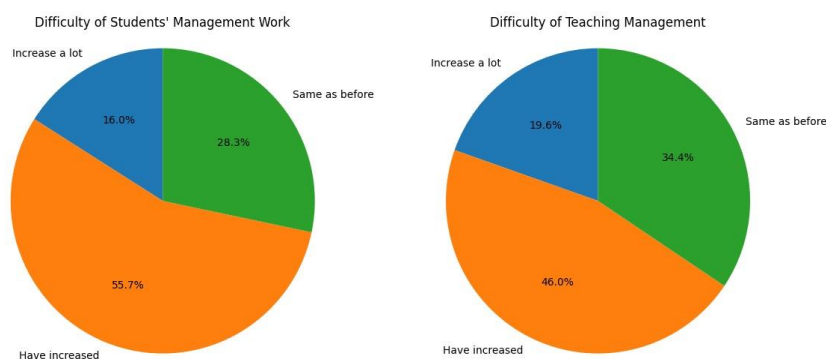| After the implementation of credit system, teaching management is difficult	percent
Increase a lot	19.6%
Have increased	46%
Same as before	34.4%

Fig 2: Student Management and Teaching Management

The implementation of the credit system has improved students' interest and enthusiasm in learning. According to the results of questions 11 and 12 of the credit system management questionnaire for students in higher vocational colleges, 59.4% of teachers believe that a series of elective courses set up in the process of implementing the credit system have greatly stimulated students' enthusiasm for learning as shown in figure 2. Through the questionnaire analysis, as shown in Table 5, it is found that the implementation of the credit system management of personal mobile terminals has improved students' enthusiasm for interactive learning in class to varying degrees. About 95.7% of students believe that the implementation of the credit system has given full play to their learning initiative and helped them form good learning habits. 63.8% of the students also agreed that the credit system has aroused their enthusiasm for learning and stimulated their potential.

Table 7: Impact of proposed credit system management, students' classroom learning enthusiasm survey

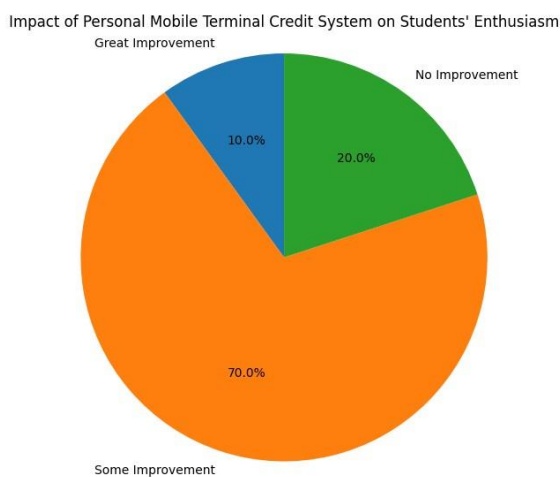| The impact of the implementation of personal mobile terminal credit system management on students' interactive enthusiasm	percent
There has been a great improvement	10%
Have some improvement	70%
No improvement	20%

Fig 3: FFOC Credit Management in Classroom

According to the descriptive data in questionnaire 2, the mean value of the eight internal variables ranges from 2.99 to 3.41, among which the mean value of Y5 (the credit system management department of higher vocational colleges can establish an effective communication mechanism with teachers and students, and maintain cooperation with excellent enterprises in the student employment market) is the lowest at 2.99 as illustrated in figure 3. Y3 (there is a special credit system management department of higher vocational colleges to collect, analyze, process and timely respond to information related to the credit system of higher vocational colleges) the highest is 3.41. The mean value of each latent variable is shown in Table 6:

Table 8: Mean of latent variables

Latent variable	ID	Measured variable	Mean value	Mean value
Curriculum management	Y1	Curriculum management 1	3.31	3.37
	Y2	Curriculum management 2	3.40	
	Y3	Curriculum management 3	3.41	
Department management	Y4	Department management 1	2.99	3.04
	Y5	Department management 2	3.05	

	Y6	Department management 3	3.10	
Update management	Y7	Update management 1	3.07	3.18
	Y8	Update management 2	3.28	

One-way ANOVA results show that there are significant differences in the "setting of course selection in the management of the personal mobile terminal credit system" in the three grades, which is manifested as the difference between the second grade and the third grade (P= 0.025, P≤ 0.05) (see Table 7), while there is no difference in other grades. The results show that vocational colleges carry out elective courses, and the students above grade two broaden their knowledge.

Table 9: Correlation analysis between credit system and grade difference (P≤ 0.05)

problem	significance	The difference between two grades		
For student credit system management, for personal mobile terminal Settings, your attitude is	0.025	Freshman year

Second grade | Freshman

yearJunior class | Second grade

Junior class |
| | | 0.681 | 0.138 | 0.025 |

The statistical results of independent sample T-test showed (see Table 8) that gender had a significant difference in personal mobile terminal's participation in credit system management (P≤ 0.018, P≤ 0.05). The male students do not accept the personal mobile terminal to participate in the credit system management significantly higher than the female students, and their learning enthusiasm is not high; Girls, on the other hand, are more receptive and attentive.

Table 10: Analysis of gender differences in Credit Management System(P≤ 0.05)

problem	T-value	significance	male		female	
For student credit system management, for personal mobile terminal Settings, your attitude is	0.025	0.018	Mean value	Standard deviation	Mean value	Standard deviation
			3.38	1.135	2.78	1.143

Correlation analysis showed that personal mobile terminal was positively correlated with credit course management (r=0.437, p<0.05), personal mobile terminal was positively correlated with department management relationship (r=0.289, p<0.05), and personal mobile terminal was positively correlated with update management relationship (r=0.310, p<0.05).

Table 11: Correlation analysis between personal mobile terminal and credit system management

item	Keep doing and make progress in time	High frequency of implementation	There is implementation but in the early stages	Just start doing	Have not started yet
Curriculum management1	0.437*	0.289*	0.310*	-0.067	-0.281*

Curriculum management2	0.391*	0.213**	0.318*	-0.026	-0.287*
Curriculum management3	0.297*	0.249*	0.268*	-0.031	-0.298*
Department management1	0.357*	0.218**	0.259*	-0.018	-0.261*
Department management2	0.563*	0.312*	0.298*	-0.089	-0.361*
Department management3	0.518*	0.273*	0.261*	-0.124	-0.237*
Update management1	0.318*	0.265*	0.329*	-0.069	-0.274*
Update management2	0.451*	0.248*	0.295*	-0.073	-0.241*

Note: * is $p<0.05$; * * < 0.01

Credit system is a modern teaching management mode based on solid system and resource reorganization. Compared with colleges and universities with mature governance system and sufficient educational resources, higher vocational colleges have some problems, such as short history of running schools, not deep cultural deposits, poor educational conditions, limited capital investment and low popularity. At present, China's higher vocational colleges are constructed and developed under the condition of lack of funds, lack of ideas and lack of teams, and are faced with greater survival and development pressure. This study investigated, interviewed and communicated with teaching leaders, student administrators, technical service departments and students in four higher vocational colleges to understand a series of current situations and problems. Through sorting out and summarizing the problems, the status quo and existing problems of credit system reform are mainly reflected in the following aspects.
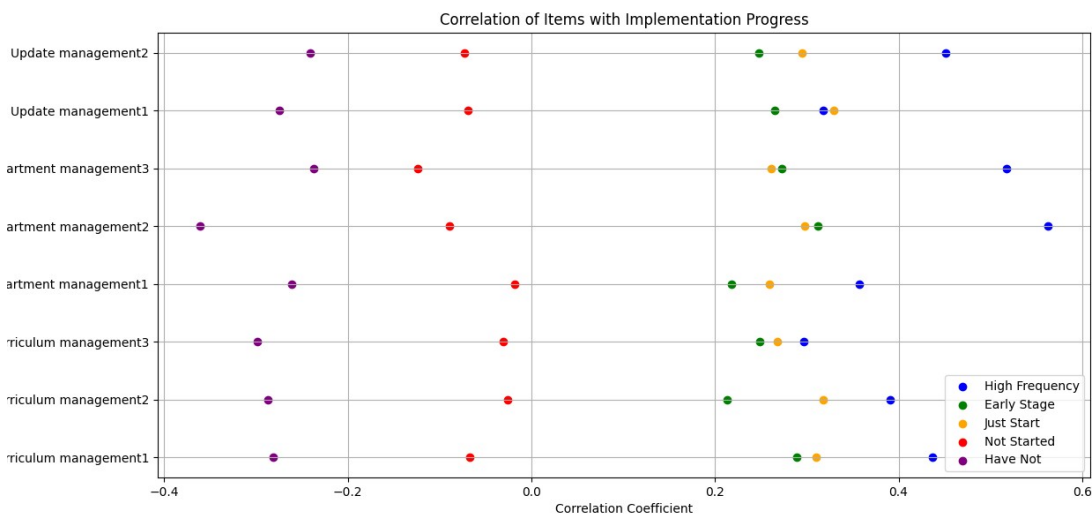

Fig 4: Correlation of FFOC

China's higher vocational colleges, especially a series of science and engineering higher vocational colleges, need a lot of equipment and resources for research and development in terms of professional environment, and it is difficult to invest money, so many research fields need a lot of resources as shown in figure 4. At the same time, because some higher vocational colleges in the process of personnel training of their own positioning and personnel training goals are not clear, in the discipline and professional tend to utilitarian, market demand and demand. There is a lack of diversity in the professional environment in school recruitment. In the survey of 4 higher vocational schools, 2 have only 5 first-level disciplines, the discipline is relatively simple. In a School

A, which is a more general education, but covers only seven subjects. Based on C higher vocational colleges, there were originally 3 branches, of which nearly 70% were related to clothing, and the student group was relatively concentrated. In 2016, the school has been adjusted into five departments, but it is still relatively concentrated. The professional environment is relatively concentrated and the subject is unified, which is not conducive to the opening of multi-subject elective courses, and it is difficult for students to choose subjects freely, which does not meet the requirements of the credit system. The distribution of disciplines and majors is too concentrated, and the number of courses in each discipline is limited. These schools cannot provide students with more and wider courses to choose from, and students cannot choose more interdisciplinary courses outside their majors to meet their needs. They can only choose according to the limited curriculum resources provided by the school and generally rely on the talent training plan formulated by the school which seriously limits the development of students to carry out talent training activities.

The lack of teachers and the low level of teachers are common problems in the development of higher vocational colleges. The weak teachers restrict the survival, development, and improvement of the quality of staff education in higher vocational colleges. In the process of credit system reform, teachers play a more important role, and its problems have seriously restricted the implementation of credit system reform plan. Referring to the problem of teachers, although the problems faced by higher vocational colleges are not the same, there are also a series of common problems.

The number of teachers in higher vocational colleges is insufficient and the quality is worrying. China's higher vocational colleges are generally faced with a serious shortage of teachers. According to the "National Statistical Data Bulletin on Education Development 2020" issued by the Ministry of Education, the ratio of teachers to students in ordinary colleges and universities is 17.73, of which 17.69 are undergraduates and 17.77 are vocational colleges. According to the education statistics of the Ministry of Education, the teacher-student ratio of ordinary higher vocational colleges will be 17:07 in 2020. Historical data show that the teacher-student ratio in China's ordinary colleges and universities is on the rise. With the continuous increase of gross enrollment ratio in China's higher vocational colleges, the rising trend of student-teacher ratio is difficult to reverse in the short term. Taking into account issues of statistical caliber (e.g. part-time teachers, temporary teachers, correspondence students, etc.), the actual number may be larger. The uneven distribution of educational resources is also a serious problem, and except for a few first-class higher

vocational colleges, the shortage of teachers in other schools is even more serious.

According to statistics, the teacher-student ratio of world-class higher vocational colleges is between 6 and 13.6. According to the No. 2 document of the Ministry of Education, the teacher-student ratio of ordinary higher vocational colleges is 18.1, and the teacher-student ratio of higher vocational colleges is far beyond this standard. As can be seen from the above table, the teacher-student ratio of the four higher vocational colleges is 19.7; 22.3; 28:1; 24.1 This is far from the ratio of the number of teachers to the number of students determined by the Ministry of Education, which shows that the teachers in vocational colleges are particularly weak. Some higher vocational colleges are more special, because of the difference in region and profession, the gap between teachers is larger. Many higher vocational colleges cannot guarantee basic teaching tasks and have to hire external teachers, who are extremely unstable and inconvenient to manage. Vocational colleges not only have a serious shortage of teachers, but also the quality of teachers is worrying. From the above student survey, it can be concluded that 64% of students are dissatisfied or especially dissatisfied with the teaching quality of private higher vocational colleges, 26% of students think it is average, and only 10% of students think it is particularly satisfied or satisfied. Due to the nature of running a school in higher vocational colleges, the structure of teachers is unreasonable, mainly new young teachers and "white hair" resource teachers (retired teachers), the age structure and title structure of teachers are seriously unbalanced, which restricts the development quality of higher vocational colleges.

Due to many reasons such as economic treatment, ecological academic and personal development, the problem of brain drain in higher vocational colleges is very serious. Higher vocational colleges have become temporary transitional units for many young people after graduation, and have also become a stage for many senior teachers of public higher vocational colleges to exert their residual heat and basic competitiveness after retirement. The lack of continuity in teaching, research, and education for students' physical and mental development has many negative effects. From the national level, the promulgation and implementation of the Law on the Promotion of Private Education has provided political support for the development of higher vocational colleges. However, due to its unclear definition and ineffective implementation, the education organizations that guarantee the development of higher vocational colleges still do not exist. In terms of professional title assessment, social benefits and many other aspects, many teachers will choose to leave due to psychological imbalance. From the social perspective, under the current social system, "iron

bowl rice" is still the most important job selection, most people believe that working in higher vocational colleges can not guarantee life, which directly leads to the lack of belonging. Among teachers, it is difficult for young teachers to find a stable state of mind under the influence of social pressure, which is also the direct cause of the brain drain in higher vocational colleges. Based on the long-term professional development plan, they only want to change careers, so they do not put too much energy into their work. Moreover, the conflict of interest between the management and employees of higher vocational colleges is quite obvious, and the school does not have enough humanistic care for the life and working conditions of teachers, which also leads to a large number of teachers in higher vocational colleges. The survey found that among the four higher vocational colleges, D school lost more teachers, the most significant. As can be seen from Table 3 below, D School loses an alarming number of teachers each year

Table 12: Statistics of brain drain in higher vocational colleges from 2017 to 2021

A given year	2017	2018	2019	2020	2021
Total teachers	544	647	675	740	662
Number of wasters	92	79	71	76	69
Loss ratio	16.91%	12.21%	10.52%	10.27%	10.42%

During the interview process, the management of B and D higher vocational colleges fell into deep confusion and could not find a good solution. B The staff of the Bureau of Research of Higher Vocational Colleges reported that B higher vocational colleges had lost 15 teachers by the end of the last semester. As the new semester approaches, schools urgently need to reduce the requirements for re-employment during holidays, which seriously affects the quality of teaching. The high mobility of teachers in higher vocational colleges means that teachers are generally overloaded with teaching. Due to the instability of the teaching staff, in the process of credit system reform, in the case of self-selected teachers, there is no large choice of fields in most cases, some courses have only one teacher, and some can not be used temporarily due to the loss of teachers. Therefore, the fluidity and instability of the teaching staff also lead to the empty talk of teacher self-selection, and the shortage of teachers has become a major obstacle to the reform of the credit system.

Table 13: Credit Management System for the FFOC

Student	Income ($)	Initial Credit Score
Student A	8000	Low
Student B	12000	Medium
Student C	6000	Low
Student D	15000	Medium
Student E	10000	Medium

Table 14: Without Proposed FFOC

Rule No.	IF Income is	THEN Credit Score is
Rule 1	Low	Low
Rule 2	Medium	Medium
Rule 3	High	High

Table 15: With the proposed FFOC

Rule No.	IF Income is	THEN Credit Score is
Rule 1	Low	Low
Rule 2	Medium	Medium
Rule 3	High	High

Table 16: FFOC for the Credit Management

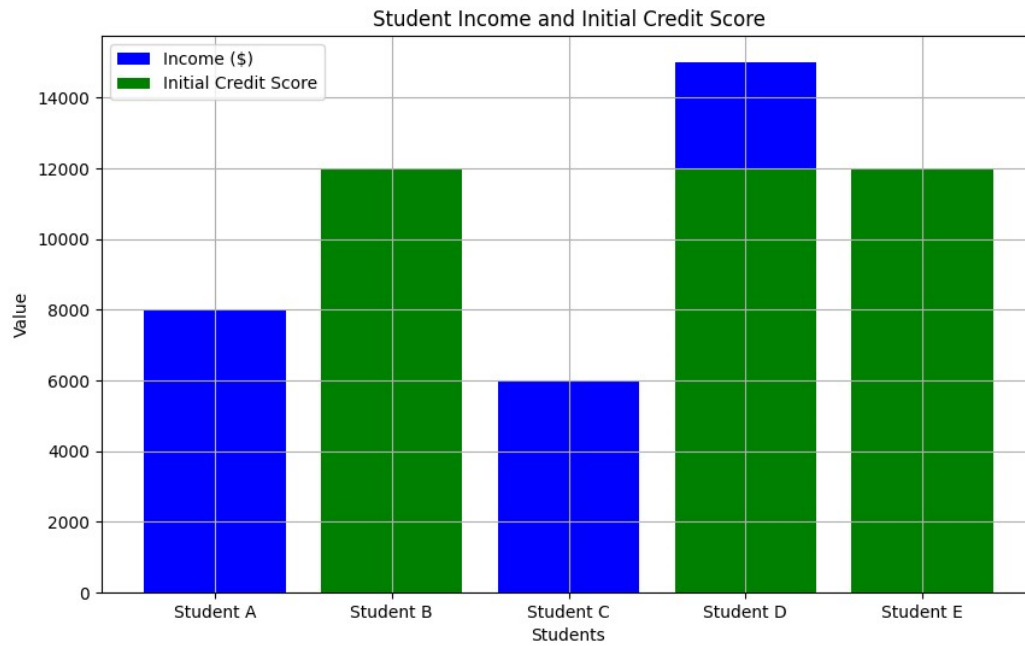| Student	Income ($)	Optimized Credit Score
Student A	8000	Low
Student B	12000	Medium
Student C	6000	Low
Student D	15000	High
Student E	10000	Medium

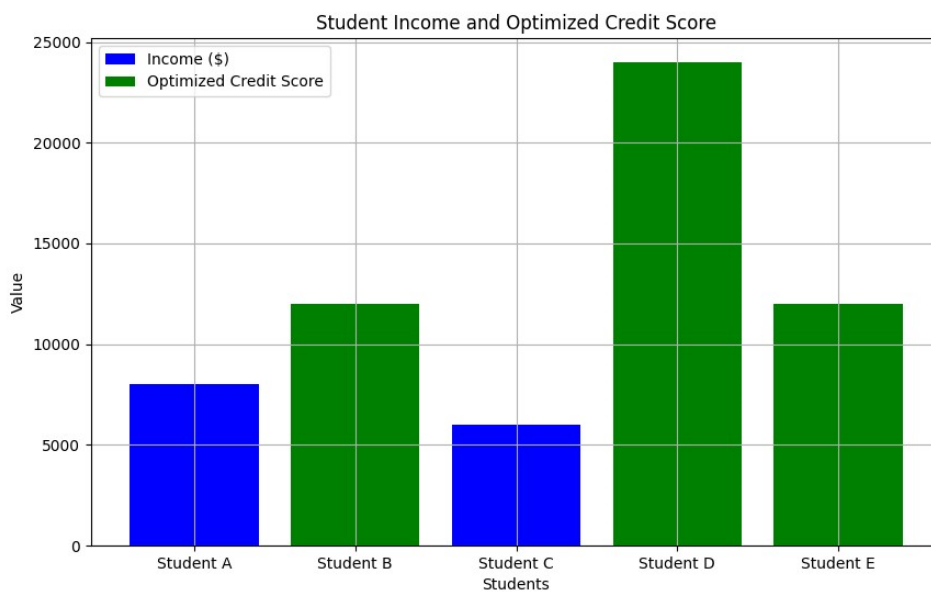

Fig 5: Credit Score with FFOC

Fig 6: Optimized Credit Score with FFOC

In the Table 13 illustrates the Credit Management System designed within the framework of the Fuzzy Firefly Optimization Classification (FFOC). The table presents student-specific data, including their income in dollars and their initially assigned credit scores. For instance, Student A has an income of $8000 and an initial credit score classified as "Low," while Student B's income of $12000 corresponds to an initial credit score classified as "Medium." This figure 5 and figure 6 provides a baseline for comparing the credit score assignments before and after applying the proposed FFOC methodology.Table 14 showcases the initial fuzzy rules for credit score assignments without the implementation of the proposed FFOC. These rules follow a straightforward mapping: if the income is categorized as "Low," the credit score is assigned as "Low"; if the income is "Medium," the credit score is classified as "Medium"; and if the income is "High," the credit score is designated as "High." These rules form the basis for credit score assignment before any optimization.

Table 15 introduces the proposed FFOC-enhanced fuzzy rules. Interestingly, these rules remain unchanged from the initial rules presented in Table 14. However, what sets Table 15 apart is the optimization process that these rules undergo within the FFOC framework. Through iterative adjustments driven by firefly optimization, these rules are refined to yield more accurate and precise credit score assignments. In Table 16, the results of applying FFOC to credit management are presented. Here, the "Optimized Credit Score" column reflects the credit score assignments after the FFOC optimization process. Notably, Student D's credit score has been optimized from "Medium" to "High," which suggests that the FFOC methodology recognized a stronger correlation between Student D's higher income and a higher credit score. The other credit score assignments remain relatively consistent with the initial or baseline assignments. These tables provide a comparative overview of credit score assignments before and after the application of the FFOC methodology. The FFOC-enhanced credit management system demonstrates its potential to fine-tune credit score assignments, resulting in more accurate and tailored assessments based on individual income levels, thereby contributing to a fairer and more informed credit evaluation process.

5. Conclusion

The integration of fuzzy logic and the firefly optimization algorithm presents a dynamic and intelligent approach to credit assessment, tailored to individual financial circumstances. The FFOC system addresses the challenges of uncertainty and imprecision inherent in credit evaluation, offering a more nuanced and personalized methodology. Through the application of fuzzy logic, the system accommodates uncertainties by assigning degrees of membership to linguistic variables, creating a flexible and adaptive framework. The use of firefly optimization algorithm further refines this framework, optimizing the parameters of fuzzy rules based on real-time data and fitness evaluations. This iterative optimization process enhances the accuracy and reliability of credit classifications, resulting in more precise credit score   assignments. The FFOC Credit System's benefits are particularly significant for vocational college students, as it empowers them with personalized credit assessments based on their unique financial situations. Through fostering responsible financial behaviors and providing accurate credit evaluations, the system contributes to students' financial literacy, stability, and future opportunities. The FFOC Credit System offers a powerful tool for credit system management in the context of vocational college students. Its combination of fuzzy logic and firefly optimization provides an intelligent and adaptable approach to credit assessment, revolutionizing the way credit evaluations are conducted. This system has the potential to shape the financial landscape for Chinese vocational college students, ensuring fair, accurate, and responsible credit management for a brighter financial future.

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