

Evolutionary Game of School Enterprise Cooperative Innovation

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Abstract: *In the current tide of The Times, the importance of professional and technical personnel is increasing day by day. However, the educational model of most relevant universities is relatively backward, resulting in insufficient quality of talents exported to various enterprises. Therefore, the school-enterprise cooperative innovation model solves this problem well. However, school-enterprise cooperation and win-win is only a superficial phenomenon, and there are various competitive game relations between schools and enterprises. The core goal of this paper is to construct an evolutionary game model of school-enterprise cooperation innovation. In this paper, the benefits of school-enterprise collaborative innovation are explained in detail to ensure the necessity of school-enterprise collaborative innovation. Then analyze the conflicts of interest among schools, enterprises and even students, establish the game relationship between them, and finally use the Jacobian matrix to complete the construction of the model.*

Keywords: *School-enterprise cooperation, Innovate, Evolutionary game*

1. Introduction

The so-called game refers to the various strategies taken by both sides to achieve their own winning goals under the condition of equality. Traditional game theory assumes that the participants are completely rational. One of the objects studied in this paper, evolutionary games, assumes that the objects are not absolutely rational, which makes the simulation more realistic. In the process of school-enterprise cooperation, there are conflicts of interest among schools, enterprises and student groups, so it is necessary to analyze the game evolution relationship of the three. This paper uses the Jacobian matrix method to achieve this goal more accurately.

In the current situation of the gradual saturation of academic talents, the gap of professional talents has gradually begun to appear. Haizhong Chen pointed out that many higher vocational colleges began to pay attention to training practical and applied talents in response to the call [1]. Yufeng Guo proposed that school-enterprise cooperation is the main means for colleges and universities to train professional talents [2]. Peng Wang believes that strengthening communication and cooperation between schools and enterprises can improve teaching quality and enhance students' practical ability [3]. Similarly, Jiang Boren is also committed to studying the positive impact of school-enterprise cooperation model on vocational education [4]. In addition, Weiwen Li also proposed that universities must carry out reforms to organically combine social industry with higher education [5].

This paper holds that there is a certain game relationship behind school-enterprise cooperation, and similar game relationship also exists in many other aspects of society. For example, Syed Abdul Rehman Khan constructed an evolutionary game model between agricultural product suppliers and urban residents [6]. At the same time, Zhen Liu believes that there is also an evolutionary game relationship between the government and family medical care [7]. Arne Traulsen sees the evolutionary game as a truly interdisciplinary discipline that goes far beyond the limits of biology

Complexity between these game objects [8]. The weighted evolution model established by Xu Cao analyzes the evolution law of industry-university-research cooperation, and also confirms the viewpoint of this paper, indicating that school-enterprise cooperation does exist certain evolution law [9].

Qiqiang Chai believes that today's enterprises are faced with a complex market competition environment, which is caused by homogenized competition [10]. In order to avoid homogenization and vicious competition, enterprises need school-enterprise cooperation and innovation to overcome this dilemma. The essence of school-enterprise cooperation is that schools provide talents for enterprises

through education. If the major and position are inconsistent, it will undoubtedly become the internal friction between schools, enterprises and students. The end result is to damage the reputation of the school, increase the cost of training and recruitment for enterprises, and delay the future of students. Therefore, enterprises should actively look for schools with corresponding majors, and should set the number of positions according to the actual situation of enrollment (such as the proportion of humanities and sciences). These views have also been confirmed in Guoliang Zhong research, and he believes that the integration of industry and education is conducive to the development of enterprises [11].

2. Matters Related to School Enterprise Cooperation and Innovation

2.1 Professional education in cooperative schools should be in place

Schools are actually the most important link in the chain of school-enterprise cooperation, because students have just made the transition from general education to professional education. It is difficult to make a correct judgment on the choice of professional courses, the employment prospects of the major studied, and the quality of teaching. Ying Fang has always raised the issue of major selection, which is a hot issue concerned by the majority of students [12]. Therefore, in order to do a good job in education, schools should constantly update textbooks and teaching models to prevent the outdated professional knowledge taught from making it difficult for students to apply it in practice after employment. It is also necessary to set up a special employment department to pay close attention to the employment environment and analyze at any time which professions are emerging professions with potential and which are sunset industries facing elimination. Always pay attention to the student's career plan and give guidance. Qiang Xia once proposed in his research that schools should pay attention to entrepreneurship and entrepreneurship education (innovation and entrepreneurship education, an educational course aimed at promoting college students' employment)[13].

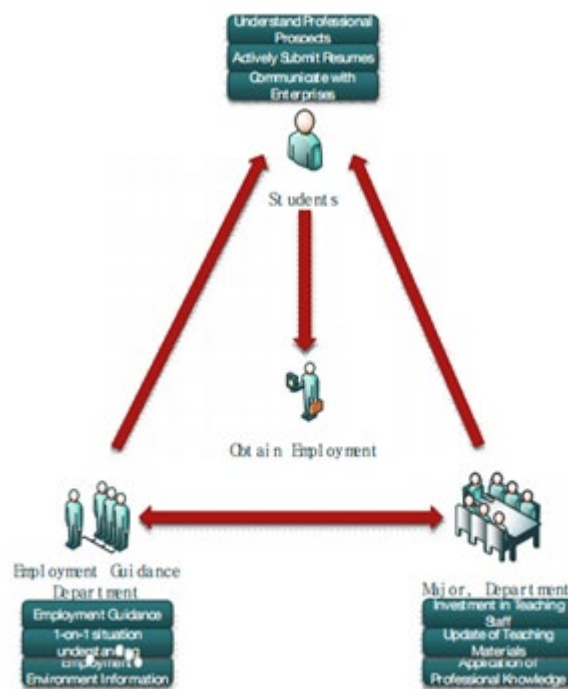


Figure 1: Employment assistance for students within the school

As is shown in Figure 1, schools should establish career guidance departments to provide students with professional career guidance and analysis of job prospects. If some students need it, they can provide special one-on-one instruction. In the course of teaching, it is necessary to update the teaching materials of each major and each department in time to ensure that students apply what they have learned. In addition to fully mastering professional knowledge, students themselves also need to independently understand their own employment prospects, as the opinion of the employment department may not necessarily meet the needs of all large employers. If you have no other plans, you should actively submit your resume before graduation, participate in an internship, or identify a

workplace as early as possible. It can be seen that the employment within the school should be trinity, mobilizing the employment department, the professional departments and the students themselves to ensure the competitiveness of students in the job market. Yufeng Deng also put forward a similar idea, pointing out that innovative education models such as enterprise admission and dual education should be implemented on campus [14].

2.2 Legal issues of school-enterprise cooperation

Changguo Zhou believes that improving the rules and regulations of schools and enterprises and clarifying the legal relationship between schools and enterprises and students can reduce many unnecessary conflicts and promote school-enterprise cooperation [15]. First of all, the financial issues involved in school-enterprise cooperation should be dealt with comprehensively in accordance with the law to avoid unclear handling methods. Secondly, as the third group of school-enterprise cooperation and the main body of talent export, the interests of students should be fully protected. Both schools and businesses should create incentives to ensure that students' participation in collaborative projects is beneficial to them. Finally, enterprises should strictly abide by the labor law when hiring personnel to prevent illegal activities at work, which will not only infringe on the legitimate rights and interests of students, but also lose the positive image of the enterprise and even face compensation. Based on the above points, both schools and enterprises need to strictly abide by the rules and regulations and not cross the legal red line to maintain the smooth progress of cooperation.

Table 1. Matters related to cooperation between schools, enterprises, and students

	School	Enterprise	Student
Establishment or Selection of Majors	Based on the Employment Environment	Based on Enrollment Status	Based on One's Own Situation
Self-Improvement	Textbooks Innovation	Company Environment Improvement	Study Hard
Legal Issues	Comply with Rules and Regulations	Compliance with Labor Laws	Use the Law to Protect One's Own Rights

Table 1 summarizes the issues related to school-enterprise student cooperative innovation. To sum up, all three parties need to seriously consider the setting and selection of professional positions, and always ensure self-improvement to ensure that the school can send enough outstanding talents to the enterprise. Finally, there is the question of law. Each party must ensure that its own interests are not infringed, and at the same time, the interests of others are not infringed.

3. Evolutionary game of school-enterprise cooperation

3.1 Competition behind school-enterprise cooperation

On the surface, schools and businesses should work together to better achieve their respective goals, but in reality, there is potential competition between the two sides.

It has been said that school-enterprise cooperation is essentially a behavior in which both parties pursue interests by establishing a contractual relationship [16]. Because school-enterprise cooperation is only a profit-seeking relationship, both sides can cooperate and compete for profit. This paper analyzes the benefits of schools, enterprises and students.

As an exporter of professional talents, schools are mainly responsible for teaching, providing accommodation and employment guidance for students within the framework of school-enterprise cooperation. It can be seen that the work of the school is aimed at the students, and the indicators that reflect the teaching ability of the school are naturally the destination of the graduates and the scores of the new students in the college entrance examination, which can reflect the ability of the students. The stronger the ability of the school to export talents, the more it can attract investment in educational resources, which is the fundamental interest of the school.

As an absorber of professional talents, enterprises naturally want to recruit graduates with

professional matching and strong working and learning ability, so as to generate income. From another point of view, in order to save costs, enterprises can also try to reduce the wages and benefits of new students.

As professionals, students want to graduate and find the job they want. The success rate of finding employment opportunities through social recruitment channels is generally lower than that of school recruitment, and under the current trend of school-enterprise cooperation, students naturally become the third party of school-enterprise cooperation. While students are in school, they may face the problem of the school's employment department rushing them to find a job by any means necessary to achieve their goals, resulting in students being wrongly placed in a company that is not suitable for them. After entering the enterprise, students may also face various difficulties in the workplace, and the problem of students' interests is obvious, that is, they can find a suitable job in the competition between schools and enterprises, and at the same time, they must protect their legitimate rights and interests.

3.2 Game logic of school-enterprise cooperation

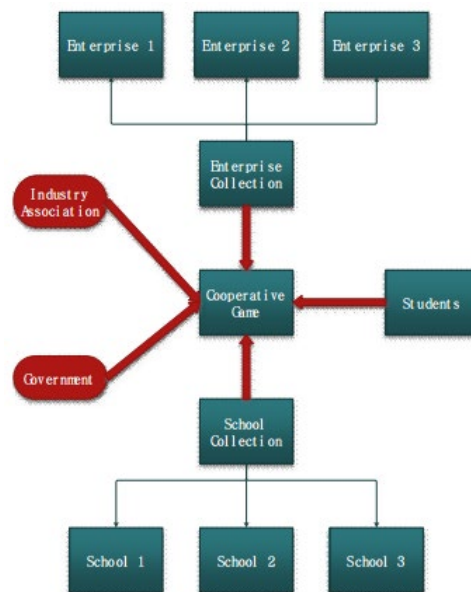


Figure 2. Simplified diagram of the tripartite relationship between schools, enterprises, and students

It is interesting to see from Figure 2 that the two sides of the game relationship are represented by "school group" and "enterprise group" respectively, which also reflects the real situation of school-enterprise cooperation in today's social environment. Many schools and businesses are involved in this game, not just between two individuals. So, consider the three parties mentioned above Interest relationship, it is not difficult to draw the following game relationship. Schools need to improve the quality of student resources by investing in various educational resources, achieve some internal results, such as scientific research results or employment completion, and then attract more educational resources through the results. From the perspective of completing employment, the school also needs to cooperate with more excellent enterprises to ensure the smooth export of talents. On the other hand, enterprises can also choose cooperative schools, because there are differences in teaching quality and professional direction between schools, and graduates of more suitable schools can create more value for enterprises. Finally, there are the students who are caught in the middle of the school-enterprise game, and they express their simple demands, hoping to get a satisfactory job and avoid becoming the victims of the school-enterprise game. It can be seen that there is indeed an evolutionary game relationship behind school-enterprise cooperation. Duan D uses the reputation model to study school-enterprise cooperation in vocational education in Beijing [17].

4. Construction of evolutionary game model based on Jacobian matrix

The evolutionary game problem is a special problem involving many variables. This paper aims to solve the evolutionary game problem by Jacobi matrix formula. Sun-Oh Park believes that the Jacobian matrix formula can solve many problems with large degrees of freedom and many variables [18]. Wen

Haiyan proposed an evolutionary game model to study the four-way game among college students, netizens, network media, universities and the government [19]. The expected return matrix of network media is A, the expected return matrix of college students and netizens is B, the expected return matrix of universities is C, and the expected return matrix of government is D. A, b, c, d are the probabilities that each group executes its most desired strategy. These strategies expect online media to report, college students and netizens to participate in the discussion of hot topics, universities to deal with the losses caused by hot topics, and the government to strictly regulate gossip. Finally, through a series of matrix evolution, we get

Jacobian matrix formula J for constructing the expected return matrix of the four-party game:

$$J(a, b, c, d) = \begin{pmatrix} \frac{\partial A(a, b, c, d)}{\partial a} & \frac{\partial A(a, b, c, d)}{\partial b} & \frac{\partial A(a, b, c, d)}{\partial c} & \frac{\partial A(a, b, c, d)}{\partial d} \\ \frac{\partial B(a, b, c, d)}{\partial a} & \frac{\partial B(a, b, c, d)}{\partial b} & \frac{\partial B(a, b, c, d)}{\partial c} & \frac{\partial B(a, b, c, d)}{\partial d} \\ \frac{\partial C(a, b, c, d)}{\partial a} & \frac{\partial C(a, b, c, d)}{\partial b} & \frac{\partial C(a, b, c, d)}{\partial c} & \frac{\partial C(a, b, c, d)}{\partial d} \\ \frac{\partial D(a, b, c, d)}{\partial a} & \frac{\partial D(a, b, c, d)}{\partial b} & \frac{\partial D(a, b, c, d)}{\partial c} & \frac{\partial D(a, b, c, d)}{\partial d} \end{pmatrix} \quad (1)$$

In addition to the above cases, Qiang Xiong also used the Jacobian matrix to build an evolutionary game model, and his research focuses on network security vulnerability sharing platforms, software manufacturers and hackers [20]. Similarly, X is the expected return matrix of the sharing platform, Y is the expected return matrix of the software manufacturer, and Z is the expected return matrix of the hacker. Let X be the probability of expecting to disclose information on a shared platform, y the probability of expecting a member to sign up, and z the probability of trying to hack the program. The final Jacobian matrix is constructed as follows:

$$J(x, y, z) = \begin{pmatrix} \frac{\partial X(x, y, z)}{\partial x} & \frac{\partial X(x, y, z)}{\partial y} & \frac{\partial X(x, y, z)}{\partial z} \\ \frac{\partial Y(x, y, z)}{\partial x} & \frac{\partial Y(x, y, z)}{\partial y} & \frac{\partial Y(x, y, z)}{\partial z} \\ \frac{\partial Z(x, y, z)}{\partial x} & \frac{\partial Z(x, y, z)}{\partial y} & \frac{\partial Z(x, y, z)}{\partial z} \end{pmatrix} \quad (2)$$

In both cases, many subjects are in a game state. In the first case, online media spread some university public opinions on various social platforms on the Internet, and college students naturally want to participate in the discussion of public opinions. The university itself, as the object of discussion, hopes to dispel rumors whether the public opinion is true or false. As a social regulator, the government is also in a dilemma at this time, allowing the spread of public opinion will lead to social contradictions, while controlling public opinion will further intensify social contradictions. In the second case, as the target of hacker attacks, software vendors are naturally inclined to register members of network security vulnerability sharing platforms, hoping to prevent hacker attacks. The platform can also evaluate the quality of the vendor's software and choose whether to implement a "closed disclosure" policy. School-enterprise cooperation also has an evolutionary game relationship, which can also be modeled by Jacobian matrix.

5. Conclusion

This paper first enumerates the innovative mode of school-enterprise cooperation to prove its superiority, otherwise the analysis of this mode will lose its significance. Then, the game relationship between the university and the students is analyzed, and the Jacobian matrix is used to build the model. Finally, the evolutionary game analysis of school-enterprise cooperation innovation is completed. However, the analysis of some parts of this paper is insufficient, and the matrix evolution of Jacobian

matrix is not decomposed in detail. Moreover, Jacobian matrix is only a modeling method, which is difficult to fully reflect the game relationship behind school-enterprise collaborative innovation. However, as a matrix tool tried and applied by predecessors, the reliability of Jacobian matrix is beyond doubt. Therefore, the analysis of this paper is still valuable for reference. The game relationship between school-enterprise cooperation and innovation can still be the research object of many scholars in the future. The more thorough the analysis of this point, the more we can predict the behavior trajectory of school-enterprise cooperation, so as to establish a framework for school-enterprise cooperative education model. It can not only ensure the interests of both sides, but also output professional talents stably and efficiently, and achieve win-win results for schools, enterprises, students and society.

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