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Study of Education and Punishment Based on Game Theory

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Abstract: Punishment as a means to regulate students' behavior has reached a consensus in Chinese education for thousands of years, but it does not play a sufficient role in guiding the specific problems in today's social practice. Based on the idea of game theory, this paper constructs a mixed strategy game model in which schools, teachers and students participate at the same time, and through the analysis of the mixed strategy Nash equilibrium of the game model, puts forward methods to reduce students' mistakes and improve students' moral level. The results show that the probability of teachers' implementation of educational discipline is mainly related to the degree of punishment for teachers' failure to implement educational discipline, the income and cost of paying attention to students' moral cultivation; Students' wrong behaviors are influenced by the spiritual benefits, costs, punishments, rewards and costs obtained by teachers' implementation of educational punishments, punishments obtained by teachers' non implementation of educational punishments, and the benefits and costs of schools' emphasis on students' moral cultivation; It will be more helpful to improve the efficiency of the standardized training of students by improving the punishment for teachers' failure to implement education discipline and students' wrong behavior and reducing the cost of paying attention to students' moral training.

Keywords: education and punishment, tripartite game, nash equilibrium

1. Introduction

Ren points out that there are obvious differences between education and punishment and discipline, corporal punishment (disguised corporal punishment), admonishment and admonishment [1]. Lu believes that rebuilding the public identity of teachers' professional identity and social status can promote the formation of a good social atmosphere of respecting teachers and valuing education [2]. Fu and Li believe that the standardized exercise of teachers' educational disciplinary power cannot be separated from the constraints of the system, and the establishment of a standardized and complete educational disciplinary system is the key to ensuring that schools and teachers exercise their disciplinary power [3].Chen, Chen and Cao believe that teachers' work pressure and teachers' quality restrict the rational use of education discipline, which is an important reason why education discipline faces many difficulties such as giving up punishment or improper punishment [4]. Liu and Du believe

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that teachers' legal literacy plays an exemplary and leading role in the development of students' behaviors, is conducive to helping students standardize their behaviors, and is of positive significance to the cultivation of students [5].

Zheng believes that the news media, judicial organs and education administrative departments should also form a tolerant social public opinion environment to guide the proper participation of guardianship and supervision [6]. Guo and Ji pay attention to the influence of the cognition of students as the educational subject on the disciplinary effect [7]. Wang, Zhang and Bai believe that schools and teachers can guide students to grow healthily by effectively performing their rights and responsibilities of disciplinary education according to laws and regulations [8]. Zhou and Fang put forward the practical confusion of implementing education and punishment, clarified the value pursuit of education and punishment, and clarified the principles and contents of education and punishment [9]. Li and Chen analyze the questionnaire and used statistics to think about the difference of stakeholders' feelings in game theory [10].

From the current relevant research literature, scholars mainly focus on the game between society, teachers, schools, parents and students, ignoring the interaction between schools, parents and students. In fact, schools urge the implementation of education and punishment by paying attention to the cultivation of students' morality to prevent students from making mistakes. Whether teachers implement education discipline and whether students make mistakes will be affected by the importance that schools attach to students' moral cultivation. At the same time, whether teachers implement education discipline and whether students choose to make mistakes will also affect schools' decision on the moral cultivation of students. In the process of reducing the number of students' mistakes and the degree of mistakes, schools, teachers and student associations participate at the same time to reduce the number of students' mistakes. The effect of reducing mistakes depends on the results of the three-party interest game. On the basis of considering the relationship among schools, teachers and students, this paper establishes a game model with the participation of three parties, and finds out the key factors affecting the equilibrium by solving the mixed Nash equilibrium of the game model, and puts forward the methods to solve the puzzle of education and punishment.

2. Problem Description

The participants in this game include schools, teachers and students. It is assumable that schools, teachers and students are all rational people and all aim to maximize their own interests. Schools' strategies are to pay attention to the cultivation of students' morality or not to the cultivation of students' morality. The strategies of teachers are to implement educational punishments or not to implement educational punishments. The strategies of students are to make mistakes or do not make mistakes. When schools pay attention to the cultivation of students' morality, it shows that schools have well implemented the fundamental teaching task of cultivating students with morality, which is conducive to establishing a good image of schools' good school spirit, attracting excellent students and excellent teachers, and also helping to improve the graduates' performance and promotion rate, thus improving the quality and reputation of schools. Thus, if schools choose to pay attention to the cultivation of students' morality, and students choose to accept punishment and correct, schools can get the benefit of V_u.

Suppose that when schools do not pay attention to the moral cultivation of students, or when schools pay attention to the moral cultivation of students and students do not make mistakes, schools' income is 0. Since schools pay attention to the moral cultivation of students, it needs to pay a certain cost (for example, the preparation of materials for the moral cultivation of students, the confirmation of the implementation of moral education by teachers to students, etc.). Therefore, this paper assumes that the cost for schools to pay attention to the moral cultivation of students is C_u.

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It also assumes that schools implement a reward and punishment system for teachers, that is, when schools pay attention to the moral cultivation of students and students make mistakes, if teachers choose to implement education and punishment and help students correct, schools will give teachers a certain reward, assuming that the reward is V_t; When schools pay attention to the moral cultivation of students and students make mistakes, if teachers choose not to implement education and punishment, schools will give teachers a certain punishment if students make mistakes, assuming that the punishment is F_t. When teachers choose to implement education and punishment, they need to pay a certain amount of time and energy. Therefore, it is assumed that the cost of teachers not implementing education and punishment is 0, and the cost of implementing education and punishment is C_t.

It is assumed that the normal profit of students not making mistakes in examinations is 0, and the spiritual profit of students making mistakes in violation of school rules is V_s.Students need to pay a certain cost for making mistakes (action plan for making mistakes, time required for making mistakes, etc.). It is assumed that this cost is C_s, so the net benefit of students' mistakes is $V_s - C_s$. As a rational person, only when $V_s - C_s < 0$, students will choose to make mistakes. Therefore, this paper assumes that $V_s - C_s > 0$. It is assumed that when schools or teachers catch students making mistakes, the punishment for students making mistakes is F_s (including station punishment, suspension of classes, notification of parents, notification of criticism, etc.). Suppose that the probability that schools pay attention to the moral cultivation of students is $(0 < P_1 < 1)$, and the probability that it does not pay attention to the moral cultivation of students is $1 - P_1$; The probability of teachers implementing educational punishment is $P_2(0 < P_2 < 1)$, and the probability of not implementing educational punishment is $1 - P2$;The probability of students making mistakes is $P_3(0 < P_3 < 1)$, and the probability of not making mistakes is $1 - P_3$.

3. Model Analysis

In the work of preventing students from making mistakes, schools, teachers and students will actually participate at the same time. In order to improve the efficiency of schools in reducing students' mistakes, and to find effective ways to improve the probability of teachers' implementation of education and punishment and reduce the probability of students' mistakes, it is necessary to build a game model involving schools, teachers and students.

The strategy combination of three-parties participation game model is as follows.

According to the collection of strategies of schools, teachers and students, it can be concluded that there are eight combinations of strategies in the game model in which the three parties participate simultaneously: pay attention to the cultivation of students' morality, implement education and punishment, and make mistakes; pay attention to the cultivation of students' morality, implement education and discipline, and do not make mistakes. Pay attention to the cultivation of students' morality, do not implement education and punishment, and make mistakes; pay attention to the moral cultivation of students, do not implement education and punishment, and do not make mistakes. Do not pay attention to the moral cultivation of students, implement education and punishment, and make mistakes. Do not pay attention to the moral cultivation of students, implement education and discipline, and do not make mistakes. Do not pay attention to the moral cultivation of students, do not implement education and punishment, and make mistakes. Do not pay attention to the moral cultivation of students, do not implement education and punishment, and do not make mistakes.

Determine the income matrix of each participant according to the model assumptions, as shown in Table 1. The game strategies and income results in the table correspond to schools, teachers and students respectively.

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Table 1: Tripartite game income matrix of schools, teachers and students.

	students: make mistakes		students: do not make mistakes	
	teachers: implement education and punishment	teachers: do not implement education and punishment	teachers: implement education and punishment	teachers: do not implement education and punishment
schools: pay attention to the cultivation of students' morality	$(V_u - C_u - V_t, V_t - C_t, V_s - C_s - F_s)$	$(V_u - C_u + F_t, -F_t, V_s - C_s - F_s)$	$(-C_u, -Ct, 0)$	$(-C_u, 0, 0)$
schools: do not pay attention to the cultivation of students' morality	$(-V_t, V_t - C_t, V_s - C_s - F_s)$	$(0, 0, V_s - C_s)$	$(0, -C_t, 0)$	$(0, 0, 0)$

From the results of teachers' income in Table 1, it can be seen that when students choose not to make mistakes, teachers choose not to implement education and punishment and always gain more profits. Therefore, there is no strategic combination between schools, teachers and students pay attention to students' moral cultivation, implementing education and punishment and not making mistakes and do not pay attention to students' moral cultivation, implementing education and punishment and not make mistakes.

At the same time, it can be seen from the income results of schools in Table 1 that when teachers choose not to implement education and punishment and students choose not to make mistakes, schools choose not to pay attention to the cultivation of students' morality and can always obtain greater income. Therefore, there is no strategic combination between schools, teachers and students pay attention to the cultivation of students' morality, not implement education and punishment and not make mistakes. Therefore, there are only five strategic combinations of the game model in which schools, teachers and students participate at the same time: pay attention to the cultivation of students' morality, implement education and punishment, and make mistakes. Pay attention to the cultivation of students' morality, do not implement education and punishment, and make mistakes Do not pay attention to the moral cultivation of students, implement education and punishment, and make mistakes. Do not pay attention to the moral cultivation of students, do not implement education and punishment, and make mistakes. Do not pay attention to the moral cultivation of students, do not implement education and punishment, and do not make mistakes. The income matrix of each participant is shown in Table 2.

Table 2: Actual income matrix of three-way game between teachers and students.

	students: make mistakes		students: do not make mistakes	
	teachers: implement education and punishment	teachers: do not implement education and punishment	teachers: implement education and punishment	teachers: do not implement education and punishment

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Table 2: （continued）

schools: pay attention to the cultivation of students' morality	$(V_u - C_u - V_t,\ V_t - C_t,\ V_s - C_s - F_s)$	$(V_u - C_u + F_t,\ -F_t,\ V_s - C_s - F_s)$	-	-
schools: do not pay attention to the cultivation of students' morality	$(-V_t,\ V_t - C_t,\ V_s - C_s - F_s)$	$(0,\ 0,\ V_s - C_s)$	-	$(0,\ 0,\ 0)$

4. Model Solving

According to the actual income matrix of the three-party game model constructed by schools, teachers and students, under the condition that schools pay attention to the probability P_1 of students' Moral Cultivation and the probability P_3 of students' mistakes, the expected income of teachers' implementation of education and punishment is:

$$E(implementeducationandpunishment) = P_1P_3(V_t - C_t)(1 - P_1)P_3(V_t - C_t) = P_3(V_t - C_t) \quad (1)$$

The expected benefits of teachers not implementing education and punishment are:

$$E(donotimplementeducationandpunishment) = P_1P_3(-F_t) + (1 - P_1)P_3 \times 0 + (1 - P_1)(1 - P_3) \times 0 = P_1P_3(-F_t) \quad (2)$$

When the profit function of teachers' implementation of education and punishment and non-implementation of education and punishment is equal, the game equilibrium is realized, that is

$$P_3(V_t - C_t) = P_1P_3(-F_t) \quad (3)$$

According to equation (3), $P_3^* = 0$ or $P_1^* = \frac{C_t - V_t}{F_t}$ can be obtained.

Since students will not make mistakes when $P3 * = 0$, it can be seen from the above analysis that when students do not make mistakes, teachers will choose not to implement education and punishment, and schools will also choose not to pay attention to students' moral cultivation. At this time, there is no game between schools, teachers and students. Therefore, this paper mainly studies the game equilibrium when the solution is $P_1^* = \frac{C_t - V_t}{F_t}$.

If schools choose to pay attention to the moral cultivation of students from the probability of $P_1 = P_1^*$, teachers can randomly decide whether to implement education and punishment; If schools choose to pay attention to the moral cultivation of students with the probability of $P_1 > P_1^*$, teachers' behavior strategy should be to choose to implement education and punishment; If schools choose to pay attention to the moral cultivation of students with the probability of $P_1 > P_1^*$ the best behavior decision of teachers should be not to implement education and punishment. Since $0 < P_1^* < 1$, this paper assumes that $C_t - V_t > 0$, which indicates that schools do not need to give too much reward to teachers to implement education and punishment.

Given the probability P_2 for teachers to implement education and punishment and the probability P_3 for students to make mistakes, the expected benefits of schools paying attention to students' moral cultivation are:

DOI: 10.54254/2753-7048/11/20230716

$$E(payattentiontomoralcultivationofstudents) = P_2P_3(V_u - C_u - V_t) + (1 - P_2)P_3(V_u - C_u + F_t) = P_3(Vu - C_u) - P_2P_3(V_t + F_t + P3F_t) \quad (4)$$

The expected benefits of schools' failure to pay attention to the moral cultivation of students are:

$$E(notpayattentiontomoralcultivationofstudents) = P_2P_3(-V_t) + (1 - P_2)P_3 \times 0 + (1 - P_2)(1 - P_3) \times 0 = -P_2P_3V_t \quad (5)$$

When schools pay attention to the moral cultivation of students and do not pay attention to the moral cultivation of students, the profit function is equal, and the game equilibrium is realized, that is

$$E(payingattentiontothemoralcultivationofstudents) = E(notpayingattentiontothemoralcultivationofstudents)$$

$$P_3(V_u - C_u) - P_2P_3(V_t + F_t) + P_3F_t = -P_2P_3V_t \quad (6)$$

According to formula (6), $P_3^* = 0$ or $P_2^* = \frac{F_t + V_u - C_u}{F_t}$ can be obtained.

When $P_3^* = 0$, there is no game between schools, teachers and students. Therefore, the main solution of this paper is that $P_2^* = \frac{F_t + V_u - C_u}{F_t}$ will implement education and punishment with the probability of $P_2 = P_2^*$, and schools can randomly choose whether to pay attention to the moral cultivation of students. If teachers choose to implement education and punishment with the probability of $P_2 > P_2^*$, schools' behavior strategy should be to choose not to pay attention to the moral cultivation of students; If teachers choose to implement education and punishment with the probability of $P_2 < P_2^*$, the best behavior decision of schools should be to pay attention to the moral cultivation of students. Since $0 < P_2^* < 1$, it is assumed that $Vu - Cu < 0$.

Given the probability P_1 that schools pay attention to the moral cultivation of students and the probability P_2 that teachers implement education and punishment, the expected return of students' mistakes in the examination is:

$$E(makemistakes) = P_1P_2(V_s - C_s - F_s) + P_1(1 - P_2)(V_s - C_s - F_s) + (1 - P_1)P_2(V_s - C_s - F_s) + (1 - P_1)(1 - P_2)(V_s - C_s) = V_s - C_s - (P_1 + P_2 - P_1P_2)F_s \quad (7)$$

$$E(donotmakemistakes) = (1 - P_1)(1 - P_2) \times 0 = 0 \quad (8)$$

Substituting P_1^* and P_2^* into equation (7), we can get:

$$E\ (\text{make mistakes}) = \frac{V_s - C_s - [F_t^2 + (V_u - C_u)(F_t + V_t - C_t)]F_s}{F_t^2} \quad (9)$$

5. Conclusion

It is of great significance to reduce the impact of students' mistakes on schools' style of study and teaching. According to the research results of the tripartite game model of schools, teachers and students, it can be seen that the probability of teachers' implementation of education and punishment and students' behavior choices of mistakes are related to the speculative income, cost, punishment intensity of students' mistakes, rewards obtained by teachers' implementation of education and punishment, costs paid, punishment obtained by not implementing education and punishment, and the income and cost of schools paying attention to students' moral cultivation.

Therefore, from the perspective of schools, the main measures to improve the probability of teachers' implementation of education discipline, prevent students from making mistakes, and improve schools' emphasis on students' moral cultivation include: improving the evaluation and assessment

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mechanism of teachers is conducive to teachers' attention to student management. schools should replace the single standard with multiple standards. It should not only focus on student's' achievements, but also include the class management, students' conduct and students' evaluation of teachers in the assessment standards. Teachers who abuse discipline and do not teach students should not be given high marks even if they have strong teaching ability and good class performance. Secondly, schools can give teachers certain rewards for the cases where the discipline of the class is good, student's' performance is improved and the education effect is remarkable due to proper punishment. At the same time, schools should encourage teachers to improve their ability to carry out education and discipline. Schools should give appropriate criticism to teachers who do not care about students who violate the rules, and at the same time increase the punishment for teachers who do not carry out education and discipline, such as reducing wages and affecting the evaluation of professional titles.

Teachers should make clear the punishment for students' mistakes. education and punishment have always been a sensitive topic in society, and the law explicitly prohibits teachers from corporal punishment and disguised corporal punishment to students. Therefore, teachers should learn relevant education laws and regulations and understand their legitimate rights and interests. At the same time, teachers can learn advanced student management experience and relevant knowledge of education discipline through the network, books, lectures and other channels, and update their own educational ideas. And in the actual educational life, in combination with the actual situation of students, teachers use relevant methods and skills to properly and effectively implement educational punishment and promote the comprehensive development of students.

Schools strictly enforce the punishment regulations. At present, many schools have strict regulations on the punishment of students' various mistakes in students' handbook, but in practical application, it is light and light, and even the punishment cannot be treated equally, and students with good results are biased. Only by strictly implementing the punishment provisions for students who make mistakes and improving the punishment for students' mistakes can schools deter students' mistakes and reduce the probability of students' mistakes. Reducing the cost of paying attention to students' moral cultivation. Schools can use various information technologies to reduce the cost of paying attention to students' moral cultivation, such as installing cameras in classrooms and schools.

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