A Study on Teachers' Norm-Violating Behaviors from the Perspective of Game Theory

Huang Yi, Liu Jin ,Wang Yijin
Chongqing Academy of Educational Science, Chongqing, China

Abstract： This study constructs static and dynamic evolutionary game models between schools and teachers based on game theory to analyze their behavioral decision-making. The results reveal an incentive paradox between teachers and schools, where inappropriate incentives and penalties reduce the effectiveness of misconduct governance. After introducing positive social feedback parameters, the model shows that sufficient positive feedback will drive both parties to strictly fulfill their ethical and supervisory duties. Accordingly, this paper proposes targeted strategies: strengthening positive incentives, improving legal constraints, and optimizing supervision modes to build a long-term mechanism.

Keywords: Incentive Paradox; Evolutionary Game; Behavioral Choice; Mechanism for the Construction of Teacher Ethics

1. Introduction

Education is a fundamental undertaking for national development, with teachers as the core force driving high-quality education. China has prioritized teacher ethics construction to build a strong education country, and the overall situation is positive. However, recent individual cases of teacher misconduct have drawn public attention and undermined policy effectiveness.

Existing research confirms the critical role of institutions in governing teacher misconduct, but an incentive paradox persists between policy goals and outcomes. Previous game models between schools and teachers neglect educational administrative departments as a key accountability actor.

This study integrates the influence of educational administrative authorities and the public into the game model, analyzes how external accountability shapes behavioral outcomes, reveals the link between policy goals and results in teacher ethics construction, and offers theoretical and practical guidance for optimizing relevant mechanisms.

2. Construction and Analysis of the Static "Incentive Paradox" Model

2.1 Model Construction

Assumption 1: The set of behavioral choices of school teachers is {abide by teacher ethics, norm-violating}, where the probability of choosing to abide by teacher ethics is x, and the probability of choosing norm-violating is 1-x. The set of strategies of school supervisors is {strict supervision, loose supervision}, where the probability of choosing strict supervision is y, and the probability of choosing loose supervision is 1-y. Among them, $x, y \in [0,1]$.

Assumption 2: School supervisors consider school reputation, education quality, and supervision costs simultaneously. When teachers engage in misconduct, schools will impose penalties under strict supervision, and educational administrative authorities will hold both deviant teachers and loosely supervising schools accountable. When teachers abide by professional ethics and schools adopt strict supervision, both parties operate normally with a payoff of 0. When teachers abide by professional ethics, schools gain additional benefits S (e.g., reputation, time savings) under loose supervision. When teachers behave misconduct, schools suffer a payoff loss D due to penalties from higher authorities if they choose loose supervision.

Assumption 3: Teachers take maximizing their own interests as the decision-making goal. When schools do not conduct supervision, if teachers take norm-violating behaviors, they can obtain comprehensive benefits P including economic benefits, professional reputation or psychological satisfaction, but they will be punished J by educational administrative departments at the same time, and P>J (the benefits of teachers' norm-violating behaviors under loose supervision are greater than the supervision punishment J they suffer). When schools conduct supervision, in addition to being punished by educational administrative departments, teachers' norm-violating behaviors will also be punished by schools, resulting in their own interest loss V.

Based on the above assumptions, the payoff matrix of the static game between teachers and schools is constructed as shown in Table 1.

Table 1. Payoff Matrix of the Static Game between Teachers and Schools

Game Subjects	School - Strict Supervision (y)	School-Loose Supervision (1-y)
Teacher - Abide by Teacher Ethics (x)	0,0	0,S
Teacher - Norm-violating (1-x)	-V-J,0	P-J,-D

2.2 Analysis of Nash Equilibrium Game Relationship

2.2.1 Mixed Strategy Nash Equilibrium Solution

At the Nash equilibrium, the expected payoff of each player is equal across all available strategies. Accordingly, the expected payoff equations for teachers and schools are established as follows:

Teachers' expected payoff equilibrium: $(1-x)*(-V-J)*y+(1-x)*(P-J)*(1-y)=0$

Schools' expected payoff equilibrium: $(1-y)*S*x+(1-y)(-D)*(1-x)=0$

After simplification and solution, the mixed strategy Nash equilibrium is obtained as: $[(\frac{D}{S+D},\frac{S}{S+D};\frac{P-J}{P+V},\frac{V+J}{P+V})]$

The mixed Nash equilibrium solution reveals that the probability x of teachers abiding by professional ethics is closely correlated with the additional benefits S obtained by schools from loose supervision and the negative loss D caused by dereliction of supervision duties, but has no direct correlation with teachers' own deviant benefits P, and the losses V and J from being penalized. Similarly, the probability y of schools implementing strict supervision is closely related to teachers' deviant benefits P and the associated losses V and J, and has no direct correlation with schools' own supervision benefits S and penalty loss D. It can be seen that the Nash equilibrium of both game parties conforms to the incentive paradox theory: that is, increasing the punishment for teachers' deviant behaviors will not reduce the probability of teachers choosing deviant strategies. Similarly, increasing the punishment for schools' loose supervision cannot raise the probability of schools adopting strict supervision behaviors.

2.2.2 Influencing Factors of Behavioral Choices of Teachers and Schools

According to the expression $x^*=\frac{D}{S+D}$ for the probability that teachers abide by professional ethics, x^* is positively proportional to the loss D incurred by schools due to dereliction, and inversely proportional to the benefit S of loose supervision. The greater the loss suffered by schools from teachers' misconduct, the stricter the supervision will be, and the higher the probability that teachers will regulate their own behavior. The more benefits schools gain from loose supervision, the lower the perceived risk of misconduct for teachers, and the lower the probability of abiding by professional ethics.

The probability that schools choose strict supervision is $y^*=\frac{P-J}{P+V}$, which is positively proportional to the benefit P of teachers' misconduct, and inversely proportional to the penalties J and V. The greater the incentive from teachers' misconduct, the more schools need to strengthen supervision. When the penalties for teachers' misconduct are smaller, schools will increase the frequency of strict supervision, partly out of concern for accountability from higher authorities, public opinion damage to reputation, and partly to prevent peer imitation of misconduct.

3. Construction and Analysis of the Dynamic Evolutionary Game Model

3.1 Model Construction

On the basis of the static game assumptions, an additional assumption is introduced: when schools exercise strict supervision and teachers abide by professional ethics, both parties will obtain indirect benefits such as social reputation and industrial influence from sound professional ethics and conduct. The indirect benefit for schools is denoted as m, and that for teachers as n. Accordingly, the evolutionary game payoff matrix is updated as follows:On this basis, the updated payoff matrix is shown in Table 2.

Table 2. Payoff Matrix of the Evolutionary Game Between Teachers and Schools

Game Subject	School: Strict Supervision (y)	School: Loose Supervision (1−y)
Teacher: Abide by Professional Ethics (x)	m,n	m,n+S
Teacher: Deviate from Professional Ethics (1−x)	−V−J,0	P−J,−D

Teachers' expected payoff for abiding by professional ethics:

$$E_1 = y\cdot m + (1-y)\cdot m = m$$

Teachers' expected payoff for engaging in deviant behaviors:

$$E_2 = y\cdot(-V-J) + (1-y)\cdot(P-J) = -y(V+J) + (1-y)(P-J$$

Teachers' average expected payoff:

$$\overline{E} = x\cdot E_1 + (1-x)\cdot E_2$$

Teachers' replicator dynamic equation:

$$F(x) = \frac{dx}{dt} = x(E_1 - \overline{E}) = x(1-x)\cdot[m-P+J+y(V+P)]$$

Similarly, the schools' replicator dynamic equation is derived as:

$$F(y) = \frac{dy}{dt} = y(1-y)\cdot(-xS+D-xD)$$

3.2 Analysis of Subject Strategy Choices

3.2.1 Analysis of Teachers' Strategy Choices

According to the stability theorem of differential equations, the probability of teachers choosing to abide by professional ethics is in a stable evolutionary state if and only if the two conditions are satisfied simultaneously: $F(x)=0$ and $\frac{F(x)}{dx} < 0$. Taking the partial derivative of $F(x)$ with respect to x, we obtain: $\frac{F(x)}{dx} = (1-2x)\cdot[m-P+J+y(V+P)]$. Let $G(y)=m-P+J+y(V+P)$. Solving the equation $G(y)=0$ yields the critical value of the school's strict supervision probability: $y^* = \frac{P-m-J}{V+P}$. It can be proved that $G(y)$ is an increasing function of y. Thus, the evolutionary stability of teachers' strategies is determined by the relationship between the actual strict supervision probability y and the critical value y^* :

When $y>y^*$, $G(y)>0$, and $x=1$ is the Evolutionary Stable Strategy (ESS) for teachers; When $y<y^*$, $G(y)<0$, and $x=0$ is the ESS for teachers. It can be seen that the probability of schools choosing strict supervision is a key parameter for teachers' strategy choices. When y is sufficiently high, teachers tend to choose to abide by professional ethics; when y is low, teachers are inclined to engage in deviant behaviors.

According to the parameter analysis, increasing the indirect benefit m of teachers' ethical compliance, intensifying the penalty J imposed by competent authorities, reducing the deviant benefit P obtained by teachers, and raising the loss V caused by teachers' misconduct will all lower the critical point y^*. This makes the condition $y > y^*$ easier to satisfy, thereby driving the probability x that teachers abide by professional ethics toward 1.

3.2.2 Analysis of Schools' Strategy Choices

Similarly, the probability that schools choose strict supervision is stable if and only if: $F(y)=0$ and $\frac{F(y)}{dy} < 0$. The critical point $= \frac{D}{S+D}$ is the key to schools' strategy selection.An increase in the penalty cost D incurred by schools due to teachers' misconduct will raise x^*, meaning schools will only choose loose supervision when the probability of teachers abiding by professional ethics is higher—in other words, schools become more inclined to implement strict supervision.An increase in the benefit S of loose supervision will lower x^*, making schools more likely to choose loose supervision; conversely, it will strengthen strict supervision.

3.3 System Stability Analysis

The equilibrium points of the evolutionary game system satisfy the following conditions simultaneously: $\frac{dx}{dt}=0$, $\frac{dy}{dt}=0$

Let $F(x)=0$ and $F(y)=0$; the evolutionary game system has 5 equilibrium points in total, including 4 pure strategy equilibrium points and 1 mixed strategy equilibrium point, which are: E1(0,0), E2(1,0), E3(0,1), E4(1,1), E5(S+DD ,P+VP−m−J)

Since the mixed strategy equilibrium in an asymmetric dynamic game is definitely not an evolutionary stable equilibrium, only the 4 pure strategy equilibrium points are analyzed in this study. To judge the stability of the pure strategy equilibrium points, the Lyapunov First Method (Indirect Method) is adopted, and the Jacobian matrix of the system is first constructed as follows:

$$\begin{matrix} \frac{\partial F(x)}{\partial x} & \frac{\partial F(x)}{\partial y} \\ \frac{\partial F(y)}{\partial x} & \frac{\partial F(y)}{\partial y} \end{matrix}$$

Taking the partial derivatives of the replicator dynamic equations with respect to x and y respectively, the elements of the Jacobian matrix are obtained:

$$J = \begin{bmatrix} (1-2x)[m-P+J+y(V+P)] & x(1-x)(V+P) \\ y(1-y)(-S-D) & (1-2y)[-xS+D-xD] \end{bmatrix}$$

According to the Lyapunov First Method,The stability of each pure strategy equilibrium point is summarized in Table 3.

Table 3. Stability of Pure Strategy Equilibrium Points of the Evolutionary Game System

Equilibrium Point	Eigenvalues	Stability Conditions
E1 (0,0)	m−P+J; D	Unstable point if m−P+J>0; Saddle point if m−P+J<0
E2 (1,0)	−(m−P+J); −S	Stable Point if m−P+J>0; Saddle point if m−P+J<0
E3 (0,1)	m+J+V; −D	Saddle point
E4 (1,1)	−(m+J+V); −S	Global ES

4. Optimization Strategies

First, enhance the indirect benefits of teachers' ethical compliance. We will establish multi-dimensional awards for professional ethics, open green channels for career development, cooperate with social forces to set up public welfare funds for teachers' ethics, and promote preferential policies in public services, so as to strengthen teachers' professional honor and social identity.

Second, strengthen penalties for misconduct. We will improve legislation related to teachers' professional ethics and set up special arbitration institutions. Schools should formulate graded internal punishment measures and link misconduct records with career development. Educational administrative departments should establish a normalized supervision and assessment mechanism and open diversified reporting channels, so as to build a multi-level constraint system covering law, school internal management and administration.

Third, optimize school supervision strategies. A risk assessment model will be constructed based on teachers' misconduct data and disciplinary characteristics to implement personalized supervision. We will rationally allocate supervision resources, use information technology to reduce supervision costs and evaluate supervision effects, and build a school-government information sharing platform to realize dynamic collaborative supervision of teachers' behaviors, so as to improve supervision accuracy and efficiency.

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