Tripartite Evolutionary Game Analysis on Collaborative Governance of Compulsory Education Students' Schoolwork Burden

Xiaoyan Cao, Xuelin Zhao

***Abstract*—The "Double reduction" policy provides essential support for achieving high-quality collaborative governance of the schoolwork burden on compulsory education students in China. In this model, the participants are public compulsory education schools (primary and secondary education) and local educational departments. Evolutionary game theory is applied to analyze the dynamic strategic changes of each participant and to simulate various governance scenarios, investigating the impact of each participant's strategy on the effectiveness of collaborative governance. The results indicate that proactive public supervision, active school management, and rigorous educational departments oversight contribute to effective governance outcomes. Rewards from educational departments and the efficacy of schools governance are critical factors influencing public engagement, thus directly shaping the public's strategic choices. Additionally, social reputation, rewards, and penalties from the educational department exhibit a strong positive correlation with a school's commitment to governance, with schools reputation having a particularly significant impact. Furthermore, societal evaluation and the overall image of local education significantly influence the evolution of regulatory strategies within educational departments. Ultimately, expanding avenues for social supervision, promptly addressing social issues, highlighting exemplary practices, enhancing public participation, refining the evaluation model for educational quality, and optimizing the school operation evaluation system will actively promote high-quality collaborative governance of schoolwork burden.**

***Index Terms*—Schoolwork Burden, Collaborative Governance, Evolutionary Game Theory, Simulation Research, Sensitivity Analysis.**

I. Introduction

THE schoolwork burden faced by students in Chinese compulsory education schools presents a significant challenge. This issue has garnered widespread attention and is a matter of concern for numerous households. The overwhelming workload not only affects students' physical and mental health but also has the potential to incite a societal crisis, thus impacting the advancement of quality education [1]. In recent years, the government has implemented a series of policies aimed at reducing the burden in compulsory education. Educational departments at all levels and schools have sequentially developed detailed lists of responsibilities, and both the public and parents have joined efforts to alleviate students' schoolwork burden effectively. In July 2021, following the issuance of the "Opinions on further reducing the burden of students' schoolwork and off-campus training in compulsory education" by the State, terms such as "Double reduction," "Improving quality and reducing burden," and "Reducing burden without reducing quality" frequently appeared in various documents across levels. However, selective implementation, symbolic efforts, and flexible applications of these measures continue to arise. The issue of student overburden in compulsory education persists, and the fundamental problem of excessive schoolwork has yet to be resolved [2]. In 2021, the Chinese Ministry of Education reported that 38% of compulsory education students nationwide had bedtime schedules later than the prescribed requirements, while 67% did not meet the standard for adequate sleep. Datas from the Chinese National Health Commission in 2022 showed a myopia rate of 36% among primary school students and 71.6% among middle school students. Additional studies in 2023 revealed a myopia rate of 46.7% among primary school students in Yunnan province and 81.1% among middle school students. In Shandong province, 37.44% of adolescents were sleep-deprived, and 46.41% were identified with psychological issues [3], [4]. Excessive schoolwork burden is recognized as a primary cause of physical health deterioration and psychological challenges among compulsory education students [5], [6], [7].

At the present stage, with high-quality resources in short supply, educational departments, schools, and the public (primarily parents) have mutually reinforced the "Double reduction" policy, leading to a recurring cycle of increased burden and attempts at reduction, driven by factors like "Performance," "Further education," and "Reputation" [8]. Although students' perceptions of schoolwork burden vary, the widespread issue of excessive burden is apparent in students' time investment and emotional stress in completing assignments [9], [10]. Researches indicates that the dynamic monitoring system for schoolwork burden, oversight of burden reduction policies, and home-school coordination mechanisms are insufficiently developed, resulting in issues such as formalistic, superficial, and data-driven approaches to burden reduction [11]. Essentially, burden reduction involves a game process among educational departments, schools, and the public [12]. Establishing a robust scientific evaluation system is crucial to address this complex situation. Existing studies mainly analyze the schoolwork burden problem, using game theory to explore various stakeholder interests and needs, while also proposing recommendations for improvement [13]. However, the schoolwork burden involves multiple stakeholders, wide-reaching implications, and a substantial population, with individuals from diverse regions and levels

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not strictly adhering to assumptions of absolute rationality. Thus, quantitative research on the dynamic evolutionary game still has considerable limitations [14]. This paper develops a tripartite collaborative governance simulation model incorporating public supervision, schools governance, and oversight by educational departments, based on the dynamic evolutionary game process governing students' schoolwork burden. The study investigates the evolutionary stable strategies of each stakeholder and examines key factors influencing each player's evolutionary path, providing critical theoretical foundations and practical recommendations for collaborative governance in this area.

II. Construction of the Model

A. Players of the model

The excessive schoolwork burden placed on students is attributed to an evolutionary game involving numerous stakeholders. The public (including parents, news media, and other groups), schools, and local educational departments serve as the three primary players in this model.

The public supervises the governance of educational departments or schools actively or passively, depending on factors such as policy understanding, family expectations, supervision costs, and the effectiveness of oversight. Parents, in particular, are concerned with students' physical and mental health, sleep duration, and emotional well-being. They can communicate their expectations to schools and teachers and raise concerns with the educational department or news media regarding significant issues in schoolwork. However, aspirations for higher education, personal time constraints, and the perceived effectiveness of lodging complaints may lead some parents to neglect or refrain from supervising schoolwork burden management. Within the public, news media carry the social responsibility of overseeing public opinion. They are able to monitor the educational departments and the handling of schoolwork burden in compulsory education. By gathering problem-related information through community reports, news media can actively supervise issues like missed classes, unapproved extracurricular tutoring, and the punitive assignment of additional schoolwork. However, factors such as available resources, costs, and the prevailing social environment may sometimes lead the media to abstain from or provide limited supervision [15], [16].

Compulsory education schools function as the primary agencies responsible for managing schoolwork burden. By aligning their practices with school development goals, student training objectives, overarching policies, teacher feedback, and public oversight, schools focus on strengthening teachers evaluation systems, standardizing teaching management, enhancing teachers quality, innovating classroom methods, and other systematic governance measures. These efforts aim to improve classroom efficiency and reduce students' schoolwork burden. Simultaneously, schools may adjust governance measures based on factors such as the intensity of oversight, rewards for effective governance, penalties for violations, and public assessments of educational departments. However, factors such as lenient evaluations from educational authorities, insufficient supervision, intense competition for higher education, and high administrative costs may result in a preference for passive governance.

The educational department is responsible for implementing burden reduction policies set by superior and local governments, tailoring operational measures to local circumstances, and supervising the policy's application in primary and secondary schools. This departments should prioritize students' physical and mental well-being and broader societal concerns by opening channels for public oversight, recognizing and rewarding proactive public supervision, and penalizing schools and teachers for negative governance practices with adverse effects. Strict monitoring of schoolwork burden management is essential to prevent disciplinary actions from higher authorities and to maintain a positive social image and responsible reputation. However, limitations such as insufficient government funding, a lack of high-quality educational resources, high regulatory costs, and substantial pressures for educational advancement may lead the educational departments to favor negative supervision. This inclination might lead to neglecting public opinion and parental oversight in addressing schoolwork burden effectively.

B. Basic hypotheses of the model

Hypothesis 1: All players in the game exhibit bounded rationality and face information asymmetry. In the tripartite random game, any change in strategy by one player will affect the others. The model incorporates parameters that represent various influential factors within the collaborative governance game [17], [18].

Hypothesis 2: Within the context of the "Double reduction" policy, the public anticipates the enforcement of high-quality education and the alleviation of students' schoolwork burden. The effectiveness of school governance depends on external oversight [19]. Negative governance by schools will lead to reprimands from educational departments and adverse social impacts. The efficacy of supervision by educational departments is influenced by performance assessments and social evaluations conducted by superior and local governments.

Hypothesis 3: During the collaborative governance process, each of the three players has two strategies. The public may choose active supervision, driven by a focus on comprehensive and balanced students development, or negative supervision, influenced by cognitive, energy, or family-related factors. Schools may choose positive governance, guided by superior policies, rewards, quality education standards, and societal feedback, or negative governance, influenced by governance costs, self-interest, and enrollment pressures. Educational departments may select positive supervision, motivated by superior oversight, public scrutiny, and the desire for a strong societal reputation. Alternatively, negative supervision may be chosen due to factors such as limited local government funding, intense higher education pressures, high supervision costs, and the broader social environment [20].

C. Parameters setting of the model

To facilitate the examination of costs, payoffs, and losses for the public, schools, and educational departments across various strategies combinations, and to explore the game process and motivation behind strategies selection, the following parameters are established, as shown in Table I.

TABLE I
MAIN PARAMETERS AND THEIR MEANINGS

Parameters	Description
C_i	Supervision cost of the public, schools and educational departments when $i = 1, 2$, and $i = 3$, respectively
T_i	Coefficient of supervision degree of the public, schools and educational departments when $i = 1, 2$, and $i = 3$, respectively
P_i	Probability of active supervision of the public, schools and educational departments when $i = 1, 2$, and $i = 3$, respectively
H	Schools' compensation to the students in the public (parents) under active supervision
G	Schools' reputation loss caused by social praise or negative governance caused by positive governance
S	Loss of students' physical health or rest time caused by schools' negative governance
N	Educational departments' rewards for actively supervising the public
B	Educational departments give incentives to positively govern schools
Q	Punishment by the superior government to the educational departments in charge of negative supervision
V	Educational departments imposed punishments on schools for negative governance
W	Loss of reputation caused by social praise or negative supervision brought by positive supervision on educational departments

D. Payoffs matrix of the model

In this game, based on the model hypotheses and parameters setting, the collaborative governance of students' schoolwork burden can be viewed as an ongoing game in which the public, schools, and educational departments continually adjust their strategies according to factors like costs, payoffs, and potential penalties. Considering various evolutionary variables and applying the principle of dynamic functions, the payoffs matrix for this tripartite evolutionary game is presented in Table II.

III. ANALYSIS ON EXPECTED PAYOFF FUNCTIONS OF REPLICATED DYNAMIC EQUATIONS

A. The public's replicated dynamic equations

According to Table I and Table II, the expected payoffs of active supervision strategy [21] is X_1:

$$\begin{aligned} X_1 =& P_2P_3(H+N-C_1)+P_2(1-P_3)(H+T_3N-C_1)\\ &+P_3(1-P_2)(T_2H+N-S-C_1)\\ &+(1-P_2)(1-P_3)(T_2H+T_3N-S-C_1). \end{aligned}$$

The expected payoffs of negative supervision strategy is X_2:

$$\begin{aligned} X_2 =& P_2P_3(-T_1C_1)+P_2(1-P_3)(-T_1C_1)\\ &+P_3(1-P_2)(-S-T_1C_1)\\ &+(1-P_2)(1-P_3)(-S-T_1C_1). \end{aligned}$$

The average expected payoffs is $\overline{X}$:

$$\overline{X} = P_1X_1+(1-P_1)X_2.$$

According to the Malthusian dynamic equation, the players' fitness equals the rates of change of their strategies [22]. Therefore, the social public's differential equation is:

$$\begin{aligned} F(X) =& dP_1/dt = P_1(X_1-\overline{X})\\ =& P_1(1-P_1)[(P_2+T_2-P_2T_2)H\\ &+(P_3+T_3-P_3T_3)N-(1-T_1)C_1]. \end{aligned} \tag{1}$$

When $P_3 = (C_1-T_1C_1-P_2H-T_2H+P_2T_2H-T_3N)/(N-T_3N)$, then $F(X)\equiv 0$, no matter how much P_1 is. Then,the public's strategy selection process is in a stable state [23]. When $P_3 \neq (C_1-T_1C_1-P_2H-T_2H+P_2T_2H-T_3N)/(N-T_3N)$, if $P_1 = 0$, or $P_1 = 1$, then $F(X) = 0$. The public's strategy selection process is in a stable state too. The partial derivative of the replication dynamic Eq. (1) is:

$$\begin{aligned} F'(X) =& (1-2P_1)[(P_2+T_2-P_2T_2)H\\ &+(P_3+T_3-P_3T_3)N-(1-T_1)C_1]. \end{aligned}$$

When $P_3 < (C_1-T_1C_1-P_2H-T_2H+P_2T_2H-T_3N)/(N-T_3N)$, if $P_1 = 0$, then $F'(X) > 0$, if $P_1 = 1$, then $F'(X) < 0$. $P_1 = 0$ is an evolutionary stable point. The stability strategy of the public is active supervision.When $P_3 > (C_1-T_1C_1-P_2H-T_2H+P_2T_2H-T_3N)/(N-T_3N)$, if $P_1 = 0$, then $F'(X) < 0$, if $P_1 = 1$, then $F'(X) > 0$. $P_1 = 0$ is an evolutionary stable point. The stability strategy of the public is negative supervision.

B. The schools' replicated dynamic equations

According to Table I and Table II, the expected payoffs of positive governance strategy [24] is Y_1:

$$\begin{aligned} Y_1 =& P_1P_3(B+G-H-C_2)\\ &+P_1(1-P_3)(T_3B+G-H-C_2)\\ &+P_3(1-P_1)(B+G-C_2)\\ &+(1-P_1)(1-P_3)(T_3B+G-C_2). \end{aligned}$$

The expected payoffs of negative governance strategy is Y_2:

$$\begin{aligned} Y_2 =& P_1P_3(-V-T_2H-G-T_2C_2)\\ &+P_1(1-P_3)(-T_3V-T_2H-G-T_2C_2)\\ &+P_3(1-P_1)(-V-G-T_2C_2)\\ &+(1-P_1)(1-P_3)(-T_3V-G-T_2C_2). \end{aligned}$$

The average expected payoffs is $\overline{Y}$:

$$\overline{Y} = P_2Y_1+(1-P_2)Y_2.$$

Therefore, the school's differential equation is:

$$\begin{aligned} F(Y) =& dP_2/dt = P_2(Y_1-\overline{Y})\\ =& P_2(1-P_2)[2G+(T_3+P_3-T_3P_3)(B+V)\\ &-(P_1-P_1T_2)H-(1-T_2)C_2]. \end{aligned} \tag{2}$$

When $P_1 = [2G+(T_3+P_3-T_3P_3)(B+V)-(1-T_2)C_2]/(H-T_2H)$, then $F(Y)\equiv 0$, no matter how much P_2 is. Then, the schools' strategy selection process is in a stable state. When $P_1 \neq [2G+(T_3+P_3-T_3P_3)(B+V)-(1-T_2)C_2]/(H-T_2H)$, if $P_2 = 0$ or $P_2 = 1$, then $F(Y) = 0$. The school's strategy selection process is in a stable state too [25]. The partial derivative of the replication dynamic Eq. (2) is:

$$\begin{aligned} F'(Y) =& (1-2P_2)[(2G+(T_3+P_3-T_3P_3)(B+V)\\ &-(P_1-P_1T_2)H-(1-T_2)C_2)]. \end{aligned}$$

When $P_1 < [2G+(T_3+P_3-T_3P_3)(B+V)-(1-T_2)C_2]/(H-T_2H)$, if $P_2 = 0$, then $F'(Y) > 0$, if $P_2 = 1$, then $F'(Y) < 0$. In other words, $P_2 = 1$ is an evolutionary

TABLE II
TRIPARTITE GAME PAYOFFS MATRIX

Players				Educational Departments	
				Positive (P_3)	Negative ($1-P_3$)
Public	Active (P_1)	Schools	Positive(P_2)	$H+N-C_1$ $B+G-H-C_2$ $W-N-B-C_3$	$H+T_3N-C_1$ $T_3B+G-H-C_2$ $-Q-W-T_3(N+B+C_3)$
			Negative ($1-P_2$)	$T_2H+N-S-C_1$ $-V-T_2H-G-T_2C_2$ $W+V-N-C_3$ $-T_1C_1$	$T_2H+T_3N-S-C_1$ $-T_3V-T_2H-G-T_2C_2$ $T_3V-Q-W-T_3N-T_3C_3$ $-T_1C_1$
	Negative ($1-P_1$)	Schools	Positive(P_2)	$B+G-C_2$ $W-B-C_3$ $-S-T_1C_1$	T_3B+G-C_2 $-Q-W-T_3B-T_3C_3$ $-S-T_1C_1$
			Negative ($1-P_2$)	$-V-G-T_2C_2$ $W+V-C_3$	$-T_3V-G-T_2C_2$ $T_3V-Q-W-T_3C_3$

stable point. The stability strategy of the school is positive governance. When $P_1 > [2G+(T_3+P_3-T_3P_3)(B+V)-(1-T_2)C_2]/(H-T_2H)$, if $P_2=0$, then $F'(Y)<0$, if $P_2=1$, then $F'(Y)>0$. $P_2=0$ is an evolutionary stable point. The stability strategy of the school is negative governance.

C. The educational departments' replicated dynamic equations

According to Table I and Table II, the expected payoffs of positive supervision strategy is Z_1:

$$\begin{aligned}Z_1 =&P_1P_2(W-N-B-C_3)\\&+P_1(1-P_2)(W+V-N-C_3)\\&+P_2(1-P_1)(W-B-C_3)\\&+(1-P_1)(1-P_2)(W+V-C_3).\end{aligned}$$

The expected payoffs of negative supervision strategy is Z_2:

$$\begin{aligned}Z_2 =&P_1P_2(-Q-W-T_3N-T_3B-T_3C_3)\\&+P_1(1-P_2)(T_3V-Q-W-T_3N-T_3C_3)\\&+P_2(1-P_1)(-Q-W-T_3B-T_3C_3)\\&+(1-P_1)(1-P_2)(T_3V-Q-W-T_3C_3).\end{aligned}$$

The average expected payoffs is $\overline{Z}$:

$$\overline{Z}=P_3Z_1+(1-P_3)Z_2.$$

The educational departments' differential equation is:

$$\begin{aligned}F(Z)=dP_3/dt=P_3(Z_1-\overline{Z})=P_3(1-P_3)[2W+\\Q+(1-P_2-T_3+P_2T_3)V-P_1(1-T_3)N\\-P_2(1-T_3)B-(1-T_3)C_3].\end{aligned}\quad(3)$$

When $P_2=[2W+Q+(1-T_3)(V-P_1N-C_3)]/[(1-T_3)(B+V)]$, then $F(Z)\equiv 0$, no matter how much P_3 is. Then, the educational departments' strategy selection process is in a stable state. When $P_2\neq[2W+Q+(1-T_3)(V-P_1N-C_3)]/[(1-T_3)(B+V)]$, if $P_3=0$ or $P_3=1$, then $F(Z)=0$. The educational departments obtain a stable state at this time. The partial derivative of the replication dynamic Eq. (3) is:

$$\begin{aligned}F'(Z)=&(1-2P_3)[2W+Q+(1-P_2-T_3+P_2T_3)V\\&-(P_1-P_1T_3)N-(P_2-P_2T_3)B-(1-T_3)C_3].\end{aligned}$$

When $P_2<[2W+Q+(1-T_3)(V-P_1N-C_3)]/[(1-T_3)(B+V)]$, if $P_3=0$, then $F'(Z)>0$, if $P_3=1$, then $F'(Z)<0$. $P_3=1$ is an evolutionary stable point. The stability strategy of the educational departments is positive supervision. When $P_2>[2W+Q+(1-T_3)V-P_1N-C_3)]/[(1-T_3)(B+V)]$, if $P_3=0$, then $F'(Z)<0$. If $P_3=1$, then $F'(Z)>0$. $P_3=0$ is an evolutionary stable point. The stability strategy of the educational departments is negative supervision.

IV. EVOLUTIONARY STABLE STRATEGY SOLVING AND SIMULATION ANALYSIS

A. Solution of local equilibrium points and analysis of evolutionary stable strategies

From analyzing the expected payoffs functions of the replicator dynamic equations [26] , it is evident that the evolutionary game of collaborative governance of students' schoolwork burden can form the following three-party replicator dynamic system by combining Eq. (1), Eq. (2) and Eq. (3), as shown in Eq. (4):

$$\begin{cases}\begin{aligned}F(X)=&P_1(1-P_1)[(P_2+T_2-P_2T_2)H\\&+(P_3+T_3-P_3T_3)N-(1-T_1)C_1],\\F(Y)=&P_2(1-P_2)[2G+(T_3+P_3-T_3P_3)(B\\&+V)-(P_1-P_1T_2)H-(1-T_2)C_2],\\F(Z)=&P_3(1-P_3)[2W+Q+(1-P_2-T_3\\&+P_2T_3)V-P_1(1-T_3)N-P_2(1-\\&T_3)B-(1-T_3)C_3].\end{aligned}\end{cases}\quad(4)$$

When $F(X)=0$, $F(Y)=0$ and $F(Z)=0$, Eq. (4) has 14 partial equilibrium points. They are: $E_1(0,0,0)$, $E_2(1,0,0)$, $E_3(0,1,0)$, $E_4(0,0,1)$, $E_5(1,1,0)$, $E_6(1,0,1)$, $E_7(0,1,1)$, $E_8(1,1,1)$, $E_9(0,(2W+Q+(1-T_3)(V-C_3))/((1-T_3)(V+B)),((1-T_2)C_2-2G-T_3(B+V))/((1-T_3)(B+V))$, $E_{10}(1,(2W+Q+(1-T_3)(V-N-C_3))/((1-T_3)(B+V)),(-2G+(1-T_2)(H+C_2)-T_3(B+V))/((1-T_3)(B+V))$, $E_{11}((2W+Q+(1-T_3)(V-C_3))/(1-T_3)N),0,((1-T_1)C_1-T_2H-T_3N)/((1-T_3)N)$, $E_{12}((1-T_1)C_1-H-T_3N)/((1-T_3)N),1,(2W+Q-(1-T_3)(B+C_3))/((1-T_3)N))$, $E_{13}((2G+T_3(V+B)-(1-T_2)C_2)/((1-T_2)H),((1-T_1)C_1-T_2H-T_3N)/((1-T_2)H),0)$, $E_{14}((2G+V+B-(1-T_2)C_2)/(1-T_2)H,((1-T_1)C_1-T_2H-N)/((1-T_2)H),1)$.

B. Equilibrium points asymptotic stability and evolutionary stable strategies analysis

According to evolutionary game theory, the strict Nash equilibrium in an asymmetric game is a pure strategy equilibrium, and the evolutionary stable equilibrium must also be

a strict Nash equilibrium [27]. Therefore, a mixed strategy equilibrium cannot be an evolutionary stable equilibrium. This paper focuses exclusively on analyzing the asymptotic stability of the pure strategy Nash equilibrium.

Based on the Lyapunov discriminant method, determining the asymptotic stability of equilibrium points requires calculating the Jacobian matrix and their eigenvalues. An equilibrium point where all eigenvalues are negative represents an asymptotically stable point of the game [28]. Conversely, an equilibrium point where all eigenvalues are positive represents an evolutionary instability point of the game. An equilibrium point with both positive and negative eigenvalues is classified as a saddle point. The Jacobian matrix of the system is as follows:

$$J = \begin{bmatrix} \partial X/\partial P_1 & \partial X/\partial P_2 & \partial X/\partial P_3 \\ \partial Y/\partial P_1 & \partial Y/\partial P_2 & \partial Y/\partial P_3 \\ \partial Z/\partial P_1 & \partial Z/\partial P_2 & \partial Z/\partial P_3 \end{bmatrix}, \quad (5)$$

where $\partial X/\partial P_1 = (1-2P_1)[(P_2+T_2-P_2T_2)H+(P_3+T_3-P_3T_3)N-(1-T_1)C_1]$, $\partial X/\partial P_2 = P_1(1-P_1)(1-T_2)H$, $\partial X/\partial P_3 = P_1(1-P_1)(1-T_3)N$, $\partial Y/\partial P_1 = -P_2(1-P_2)(1-T_2)H$, $\partial Y/\partial P_2 = (1-2P_2)[2G+(T_3+P_3-T_3P_3)(B+V)-(P_1-P_1T_2)H-(1-T_2)C_2]$, $\partial Y/\partial P_3 = P_2(1-P_2)(1-T_3)(B+V)$, $\partial Z/\partial P_1 = -P_3(1-P_3)(1-T_3)N$, $\partial Z/\partial P_2 = -P_3(1-P_3)(1-T_3)(B+V)$, $\partial Z/\partial P_3 = (1-2P_3)[2W+Q+(1-P_2-T_3+P_2T_3)V-(P_1-P_1T_3)N-(P_2-P_2T_3)B-(1-T_3)C_3]$.

The asymptotic stability of the pure strategy Nash equilibrium point $E_1(0,0,0)$ is analyzed as an example in the paper, and the stability of other pure strategy equilibrium points can be compared and analyzed. The Jacobian matrix of the pure strategy Nash equilibrium point $E_1(0,0,0)$ is:

$$J_0 = \begin{bmatrix} \lambda_1 & 0 & 0 \\ 0 & \lambda_2 & 0 \\ 0 & 0 & \lambda_3 \end{bmatrix}. \quad (6)$$

The eigenvalues of the matrix are $\lambda_1 = T_2H+T_3N)-(1-T_1)C_1$, $\lambda_2 = 2G+T_3(B+V)-(1-T_2)C_2$, $\lambda_3 = 2W+Q+(1-T_3)(V-C_3)$. According to evolutionary game theory, when the eigenvalues of the Jacobian matrix are less than zero, applying the Lyapunov criterion reveals that the equilibrium point is an asymptotic stable point. When the eigenvalues are greater than zero, the equilibrium point is an evolutionary instability of the system [29]. When both positive and negative eigenvalues are present, the equilibrium point is the saddle point of the system. Under the premise of satisfying the model's hypotheses, in order to take into account the generality and convenience, when $2G+B+V-(H+C_2)>0$, then $\lambda_2>0$. If $\lambda_1>0$ and $\lambda_3>0$, then $E_1(0,0,0)$ is an unstable equilibrium point. If $\lambda_1<0$ or $\lambda_3<0$, $E_1(0,0,0)$ is a saddle point. Similarly, the eigenvalues and stability of the remaining equilibrium points can be obtained, as shown in Table III.

V. Simulation Analysis of Schoolwork Burden

The collaborative governance of students' schoolwork burden is an essential requirement for promoting students' holistic and healthy development, a critical aspect of implementing quality education, and a shared responsibility of the public, schools, and educational departments [17]. Considering the issues of weak initiative and insufficient external supervision in the collaborative governance of students' schoolwork burden, this paper selects the equilibrium points $E_3(1,0,1)$, $E_7(0,1,1)$, $E_8(1,1,1)$, and $E_6(1,0,1)$ for data simulation. Matlab is used to simulate the dynamic evolution process, validate the asymptotic stability of the evolutionary game system, and analyze the sensitivity of different game participants to various parameters.

A. Analysis based on data simulation

1) Negative supervision by the public, positive governance by schools, and negative supervision by the educational departments: When $H+T_3N-(1-T_1)C_1<0$, the combined rewards from the educational departments for actively supervising the public, in line with the standard supervision level, and the compensation from schools for actively supervising the students is insufficient to offset the public's supervision costs. That is, under conditions where the supervision effect of the public is negligible, the students' schoolwork burden does not significantly change, and the cost of supervision remains high, individuals are more inclined to adopt a negative supervisory approach [28]. Similarly, when $2W+Q-(1-T_3)(B+C_3)<0$, schools that implement effective governance can receive rewards from the educational departments, gain more evaluation opportunities, enhance their reputation, and achieve positive social evaluations that contribute to the school's healthy development. Under these conditions, $E_3(0,1,0)$ becomes a stable state.

To better visualize the evolutionary trajectories of each player, values are assigned based on the asymptotic stability conditions: $C_1=10$, $C_2=13$, $C_3=16$, $T_1=0.1$, $T_2=1$, $T_3=0.1$, $H=1$, $G=4$, $N=2$, $B=3$, $Q=5$, $V=6$, $W=2$. The phase diagram of the data simulation is shown in Fig.1. Additionally, when $T_1=0.6$ and $T_3=0.6$, while keeping the other parameters' values unchanged, $E_3(0,1,0)$ transitions into an unstable state, as shown in Fig.2.

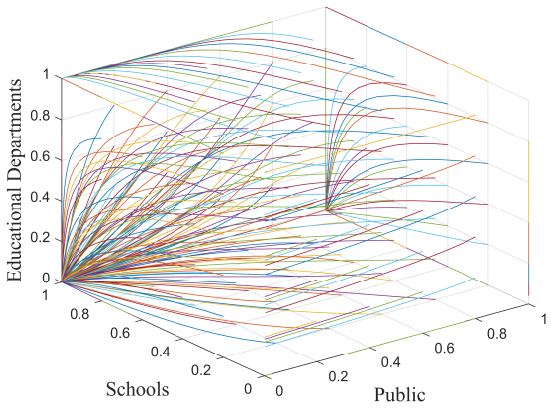

Fig. 1. Data Simulation on Negative Public, Positive Schools and Negative Educational Departments (Scenario One)

2) Negative supervision of the public, positive governance of schools, and positive supervision of educational departments: When $H+T_3N-(1-T_1)C_1<0$ and $2W+Q-(1-T_3)(B+C_3)>0$, schools choose to continue prioritizing positive governance. However, the negative supervision by the educational departments is likely to result in

TABLE III
PARTIAL STABILITY ANALYSIS OF EQUILIBRIUM POINTS

Equilibrium Points	Eigenvalues	Stability
$E_1(0,0,0)$	$\lambda_1 = T_2H + T_3N - (1-T_1)C_1$ $\lambda_2 = 2G + T_3(B+V) - (1-T_2)C_2 > 0$ $\lambda_3 = 2W + Q + (1-T_3)(V-C_3)$	$\lambda_1 > 0$ and $\lambda_3 > 0$, Unstable Point $\lambda_1 < 0$ or $\lambda_3 < 0$, Saddle Point
$E_2(1,0,0)$	$\lambda_1 = (1-T_1)C_1 - T_2H - T_3N$ $\lambda_2 = 2G + T_3(B+V) - (1-T_2)(H+C_2) < 0$ $\lambda_3 = 2W + Q + (1-T_3)(V-N-C_3)$	$\lambda_1 < 0$ and $\lambda_3 < 0$, Unstable Point $\lambda_1 > 0$ or $\lambda_3 > 0$, Saddle Point
$E_3(0,1,0)$	$\lambda_1 = H + T_3N - (1-T_1)C_1$ $\lambda_2 = -2G - T_3(B+V) + (1-T_2)C_2 < 0$ $\lambda_3 = 2W + Q - (1-T_3)(B+C_3)$	$\lambda_1 < 0$ and $\lambda_3 < 0$, Unstable Point $\lambda_1 > 0$ or $\lambda_3 > 0$, Saddle Point
$E_4(0,0,1)$	$\lambda_1 = T_2H + N - (1-T_1)C_1$ $\lambda_2 = 2G + B + V - (1-T_2)C_2 > 0$ $\lambda_3 = -2W - Q - (1-T_3)(V-C_3)$	$\lambda_1 > 0$ and $\lambda_3 > 0$, Unstable Point $\lambda_1 < 0$ or $\lambda_3 < 0$, Saddle Point
$E_5(1,1,0)$	$\lambda_1 = -H - T_3N + (1-T_1)C_1$ $\lambda_2 = -2G - T_3(B+V) + (1-T_2)(H+C_2) < 0$ $\lambda_3 = 2W + Q - (1-T_3)(N+B+C_3)$	$\lambda_1 < 0$ and $\lambda_3 < 0$, Unstable Point $\lambda_1 > 0$ or $\lambda_3 > 0$, Saddle Point
$E_6(1,0,1)$	$\lambda_1 = -T_2H - N + (1-T_1)C_1$ $\lambda_2 = 2G + B + V - (1-T_2)(H+C_2) > 0$ $\lambda_3 = -2W - Q - (1-T_3)(V-N-C_3)$	$\lambda_1 > 0$ and $\lambda_3 > 0$, Unstable Point $\lambda_1 < 0$ or $\lambda_3 < 0$, Saddle Point
$E_7(0,1,1)$	$\lambda_1 = H + N + (1-T_1)C_1$ $\lambda_2 = -(2G + B + V) + (1-T_2)C_2 < 0$ $\lambda_3 = -2W - Q + (1-T_3)(B+C_3)$	$\lambda_1 < 0$ and $\lambda_3 < 0$, Unstable Point $\lambda_1 > 0$ or $\lambda_3 > 0$, Saddle Point
$E_8(1,1,1)$	$\lambda_1 = -H - N + (1-T_1)C_1$ $\lambda_2 = -(2G + B + V) + (1-T_2)(H+C_2) < 0$ $\lambda_3 = -2W - Q + (1-T_3)(B+N+C_3)$	$\lambda_1 < 0$ and $\lambda_3 < 0$, Unstable Point $\lambda_1 > 0$ or $\lambda_3 > 0$, Saddle Point

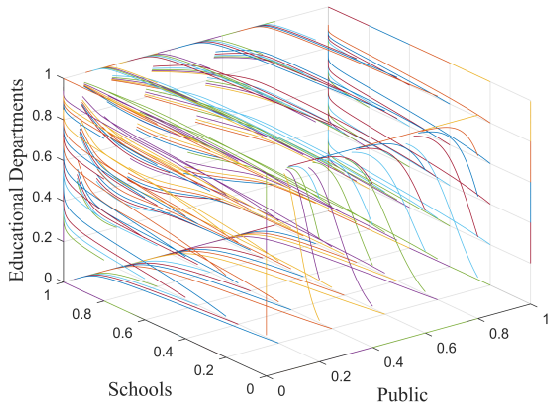

Fig. 2. Data Simulation on Negative Public, Positive Schools and Negative Educational Departments (Scenario Two)

disorderly competition among schools driven by enrollment rates. This situation may lead to a vicious cycle of increasing schoolwork burden, which not only fail to diminish but may continue to grow, severely affecting students' physical and mental health. Such outcomes can provoke widespread public dissatisfaction, parental anxiety, and significant negative social consequences, ultimately resulting in serious punishment and accountability from the superior government. The higher the costs of negligent governance within the educational departments, the greater the likelihood of opting for positive supervision. Under these conditions, $E_7(0,1,1)$ is a stable state.

Assigning values $C_1 = 10$, $C_2 = 13$, $C_3 = 16$, $T_1 = 0.2$, $T_2 = 0.9$, $T_3 = 0.8$, $H = 1$, $G = 4$, $N = 2$, $B = 3$, $Q = 2$, $V = 7$, and $W = 4$, the phase diagram of the data simulation is shown in Fig.3. Additionally, when $T_1 = 0.6$ and $T_3 = 0.5$, while keeping the other parameters' values unchanged, $E_7(0,1,1)$ transitions into an unstable state, as shown in Fig.4.

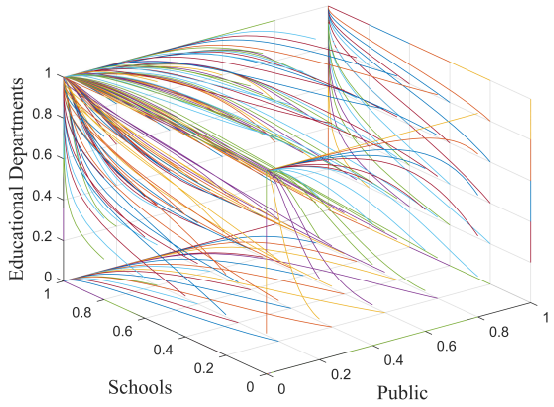

Fig. 3. Data Simulation on Negative Public, Positive Schools and Positive Educational Departments (Scenario One)

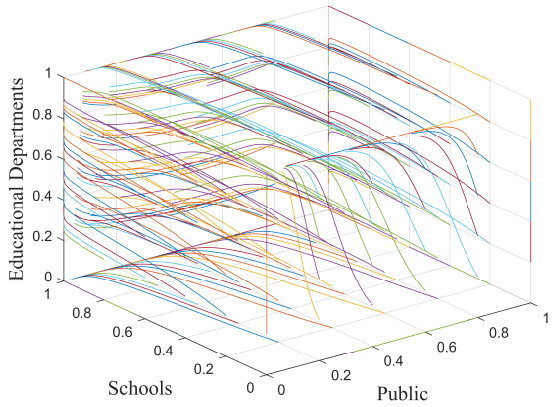

Fig. 4. Data Simulation on Negative Public, Positive Schools and Positive Educational Departments (Scenario Two)

3) Active supervision of the public, positive governance of schools, and positive supervision of educational departments: When $H + T_3N - (1 - T_1)C_1 > 0$ and $2W + Q - (1-T_3)(B+C_3) > 0$, the educational departments formulate measures to manage and supervise students' schoolwork burden. It opens channels for public supervision, promptly addresses and resolves social challenges and pressing issues, takes serious actions against school governance misconduct, establishes and maintains a positive reputation, stabilizes the foundational elements of quality education, and promotes the holistic development and progress of students. Schools actively implement the "Double reduction" policy, encouraging teachers to modernize their educational and teaching philosophies, optimize instructional methods, effectively reduce schoolwork burden, improve the quality of education and teaching, and foster positive teaching and learning outcomes.

The public's advocacy for active supervision and the reduction of schoolwork burden has been met with a proactive response from both the educational departments and schools. The rewards from the educational departments and the compensation provided by schools exceed the public's supervision costs, leading to a significant improvement in the schoolwork burden. Public awareness and engagement in participation and supervision have improved, facilitating the establishment of tripartite collaborative governance for managing the schoolwork burden. Under these conditions, $E_7(1, 1, 1)$ is a stable state.

Assigning values $C_1 = 10$, $C_2 = 13$, $C_3 = 16$, $T_1 = 0.9$, $T_2 = 0.9$, $T_3 = 0.9$, $H = 1$, $G = 4$, $N = 2$, $B = 3$, $Q = 2$, $V = 5$, and $W = 3$, the phase diagram of the data simulation is shown in Fig.5. Additionally, when $T_1 = 0.5$ and $T_3 = 0.5$, while keeping the other parameters' values unchanged, $E_7(0, 1, 1)$ transitions into an unstable state, as shown in Fig.6.

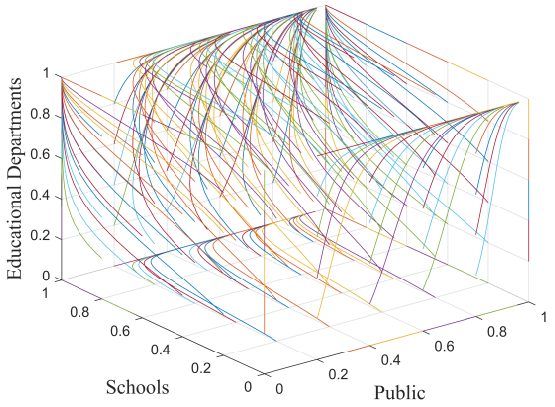

Fig. 5. Data Simulation on Active Public, Positive Schools and Positive Educational Departments (Scenario One)

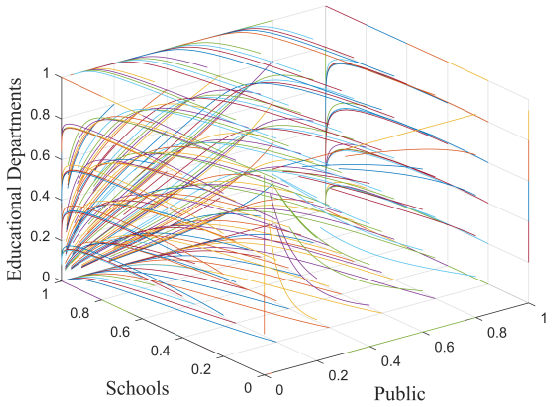

Fig. 6. Data Simulation on Active Public, Positive Schools and Positive Educational Departments (Scenario Two)

4) Active supervision of the public, negative governance of schools, and positive supervision of educational department: When $-T_2 - N + (1 - T_1)C_1 > 0$ and $-2W - Q - (1 - T_3)(V - N - C_3) > 0$, or $-T_2 - N + (1 - T_1)C_1 < 0$, or $-2W - Q - (1 - T_3)(V - N - C_3) < 0$, the public and educational departments actively supervise schools in managing students' schoolwork burden. However, due to limited public supervision channels and insufficient effort, schools donot assign it sufficient importance, resulting in a less effective governance outcome. Additionally, the educational departments, constrained by pressures related to higher education admissions and supervision costs, donot fully address these issues nor provide adequate rewards, which further limits the effectiveness of schoolwork governance.

Under these circumstances, schools are motivated to manage the schoolwork burden to some extent, yet, due to insufficient external pressures and lax measures, they may frequently shift governance strategies. Therefore, $E_6(1,0,1)$ is in an unstable state.

With parameters' values set as $C_1 = 10$, $C_2 = 13$, $C_3 = 16$, $T_1 = 0.8$, $T_2 = 0.3$, $T_3 = 0.7$, $H = 1$, $G = 3$, $N = 2$, $B = 3$, $Q = 4$, $V = 6$, and $W = 3$, the phase diagram of the data simulation is shown in Fig.7. Additionally, when $T_1 = 0.5$ and $T_3 = 0.3$, with other parameters unchanged, $E_6(1,0,1)$ remains in an unstable state, as shown in Fig.8.

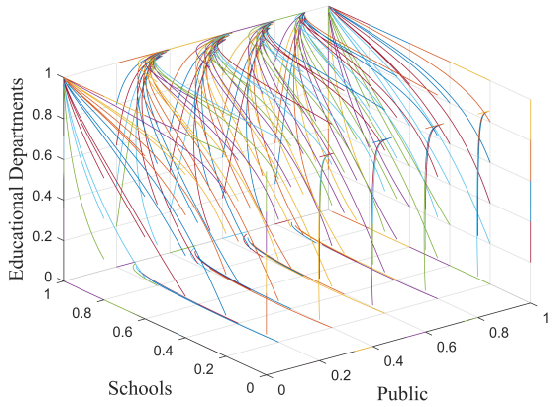

Fig. 7. Data Simulation on Active Public, Negative Schools and Positive Educational Departments (Scenario One)

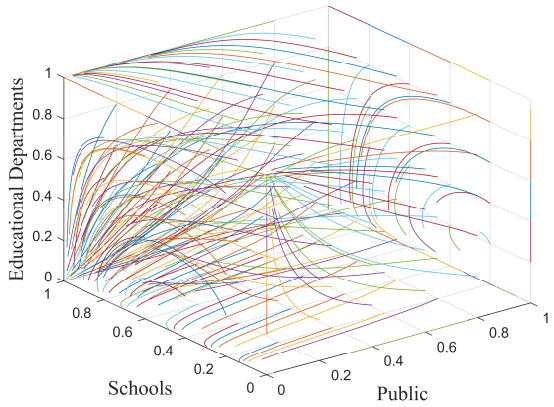

Fig. 8. Data Simulation on Active Public, Negative Schools and Positive Educational Departments (Scenario Two)

B. Sensitivity analysis on the parameters

To facilitate the comparison of the impact of different parameters on players' strategy choices and to more intuitively analyze the changing trends of players' strategies under various conditions, a sensitivity analysis of strategic choices for the general public, schools, and educational departments is conducted. Key parameters are selected to examine the extent to which different parameters influence the evolution of players' strategies. Given the constraint $0 \leq T_1^*, T_2^*, T_3^* \leq 1$, parameters values are set as $C_1 = 10$, $C_2 = 13$, $C_3 = 16$, $T_1 = 0.4$, $T_2 = 0.7$, $T_3 = 0.9$, $H = 1$, $G = 4$, $N = 2$, $B = 3$, $Q = 2$, $V = 5$, and $W = 3$. In the sensitivity analysis, the abscissa *t* represents the parameter variation interval, the ordinate indicates the corresponding strategy selection probability of the players, and the curve illustrates the evolution process of the players.

1) The impact of parameters' changes on the public's strategy choice: Rewards and compensation play a crucial role in motivating the public to actively engage in collaborative governance and serve as a key factor in the public's strategic decision-making. When the variable N, representing the rewards provided by the educational departments for active public supervision, is selected as the independent variable, a significant shift is observed in the public's strategic choices (Fig.9). When $N = 0$, the absence of an effective response to public supervision efforts, and instances where actively supervising parents are excluded or treated unfairly, cause the public to favor negative supervision, indicating ineffective social oversight. Even a slight increase in N doesnot change the trend toward a negative supervision strategy but merely slows the rate of evolution. Only when N reaches a sufficient magnitude, specifically $N = 5$ or higher, the trajectory of the public's strategic choice shift, progressing toward active supervision.

The rewards provided by the educational departments can include, but are not limited to, material incentives. For example, these rewards may involve implementing guiding and regulatory policies to manage the students' schoolwork burden, establishing accessible channels for public feedback, ensuring prompt and effective responses to individual or common issues raised by the public, and publicly disclosing the outcomes of violation cases. These measures can effectively stimulate public engagement in supervisory activities while enhancing the credibility and social reputation of the educational departments.

Similarly, H also plays a crucial role in influencing the public's strategic choices (Fig.10). When schools disregard public opinions and suggestions, and individual teachers adopt a resistant mindset by assigning punitive amounts of schoolwork, the public tends to remain silent and avoid supervision. However, a slight increase in H results in schools or certain teachers accepting public scrutiny, optimizing teaching methods, and reducing schoolwork burden. While this may slow the evolution trend of negative supervision, it doesnot alter the direction of the public's strategy choice. Only when H is sufficiently large, specifically $H = 5$ or above, and schools effectively address social supervision, update educational concepts, scientifically define student training objectives, enhance teachers competencies, and actively participate in collaborative governance, the well-being and sense of accomplishment for both the public and students significantly improve. This fosters positive interactions with public supervision and shifts the evolution direction of the public's strategic choice.

Additionally, the physical and health impacts caused by ineffective governance of schoolwork burden also influence the strategic choices of the public or parents, as shown in Fig.11. Observing the trend, it is evident that despite varying degrees of personal loss, the herd mentality among parentsstemming from a large populationpersists, leading to reluctance in actively communicating and resolving issues. Contributing factors include schools' and teachers' lack of

attention, teachers' weak willingness to make changes, and even assigning more schoolwork. This reflects that excessive schoolwork burden is a widespread issue currently in China.

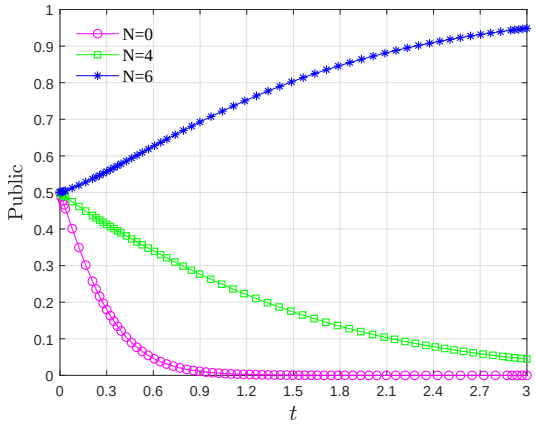

Fig. 9. The Impact of Educational Departments' Rewards on the Public

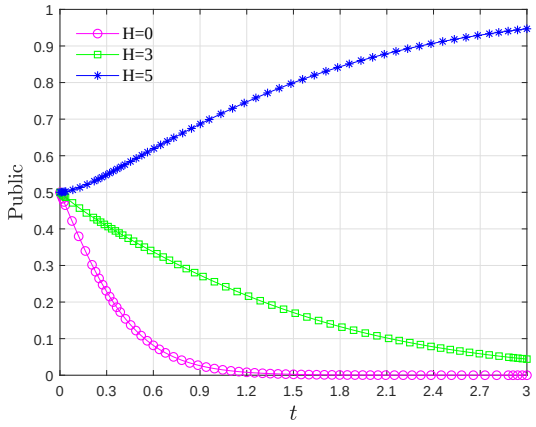

Fig. 10. The Impact of Schools Compensation on the Public

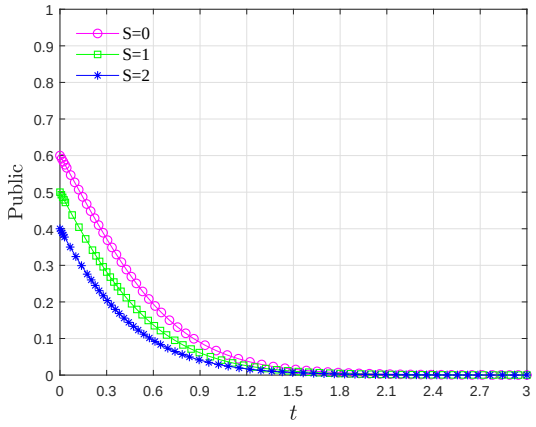

Fig. 11. The Impact on Loss of Students' Physical Health or Rest Time on the Public

2) The impact of parameters' changes on the schools' strategy choice: The fundamental task of education is to instill morality and cultivate individuals. Schools should assign appropriate schoolwork to support students' well-rounded growth. Data simulations indicate that the social reputation, rewards, and disciplinary actions implemented by the educational departments are pivotal in influencing collaborative governance of schoolwork burden. Primary and secondary schools play a critical role in delivering compulsory education, with social reputation serving as a key benchmark for assessing schools performance. The evolution trend of schools governance strategy can be observed by selecting social reputation G as the independent variable (Fig.12). When $G = 0$, even if social reputation does not impact the schools' performance assessment, the schools will tend to actively manage schoolwork burden to enhance its operational effectiveness. As the value of G increases, the direction of evolution in schools governance strategy aligns with the growth of G. The higher the G value, the faster the school adopts a positive governance approach, highlighting that social reputation greatly influences schools governance choices.

The rewards B and punishment V from the educational departments are also key factors influencing the development of schools governance strategies (Fig.13, Fig.14). Rewards for schools demonstrating effective governance or penalties for schools that perform superficially will alter the evolution rate of schools strategies. The greater the values of B and V, the faster the schools converge towards an active governance strategy. The regulatory policies of educational departments reflect the goal of managing students' schoolwork burden and promoting their physical and mental health. The degree of reward or punishment showcases the determination and resilience, which directly impacts schools' governance strategies. Schools' choice to adopt positive governance aligns not only with implementing the "Double reduction" policy to gain societal approval but also with securing additional resources and support in project applications, assessments, and evaluations within the education system. This facilitates high-quality development for schools and fosters the healthy growth of students.

Within China's current political system, educational departments exercise absolute control over schools. In cases of repeated public or parental complaints about student issues, regardless of a schools' initial willingness, intervention by the educational departments necessitates a response from the schools. For instance, if parents complain about an excessive schoolwork burden affecting their child's well-being, the school is required to respond and provide compensation to the affected students. As shown in Fig.15, regardless of the compensation amount, schools will actively implement changes. However, as compensation amounts increase, the rate of change remains relatively slow and not highly significant. The results suggest that while compensation affects school governance strategies, H is not a decisive factor.

3) The impact of parameters' changes on the educational departments' strategy choice: The educational departments serve as the administrative arm of the local government, acting as a specialized agency responsible for implementing the government's educational functions and authority. Additionally, it plays a policy-making and supervisory role in managing students' academic workload. Model analysis results indicate that social reputation W and superior government punishment Q are significant factors influencing the educational departments' strategic decisions (see Fig.16, Fig.17). When $W = 1$, the departments have progressively

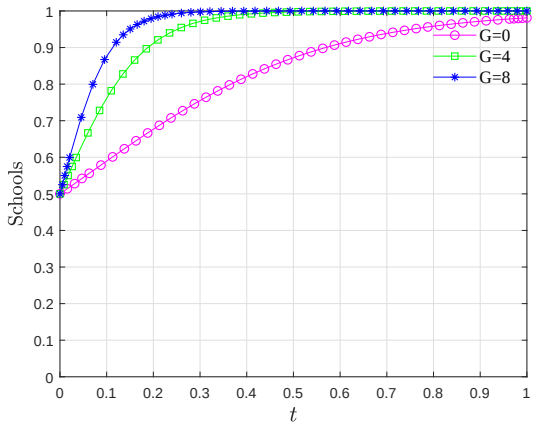

Fig. 12. The Impact of Social Reputation on the Schools

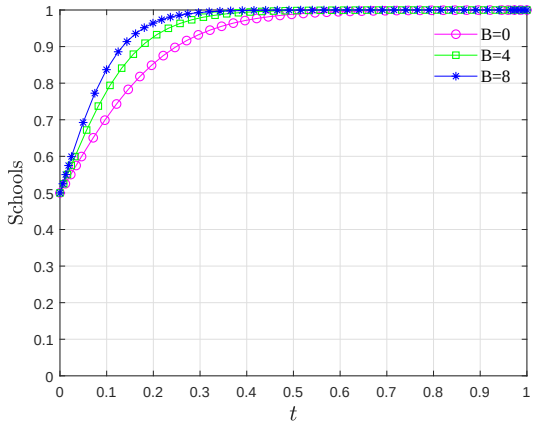

Fig. 13. The Impact of Educational Departments' Incentives on the Schools

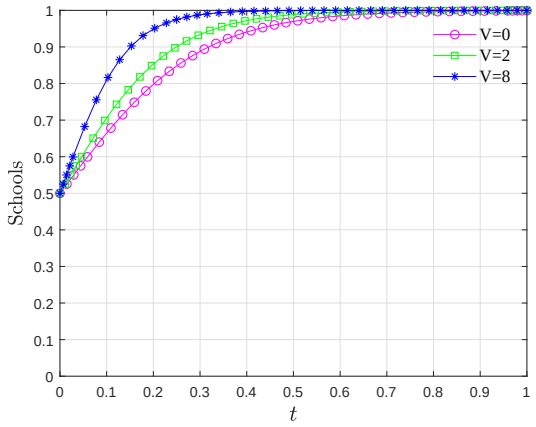

Fig. 14. The Impact of Educational Departments' Punishment on the Schools

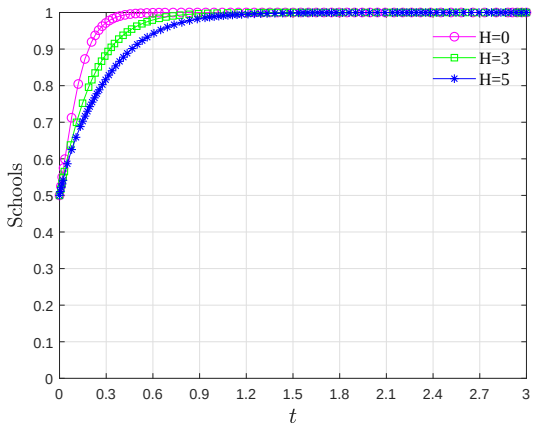

Fig. 15. The Impact of Compensation on the Schools

shifted towards positive supervision in line with superior government requirements, the developmental needs of compulsory education, and social evaluation. The impact of social reputation W is particularly notable. As W increases, its influence on the educational departments and the effectiveness of compulsory education steadily grows. Concurrently, the departments' rate of convergence toward positive supervision accelerates. A higher W value results in a more pronounced increase in this convergence rate.

Similarly, the superior government's punishment Q plays a crucial role in shaping the educational departments' strategic choices. The department's supervisory direction aligns with changes in Q, reflecting how the vertical management system steers the educational department to mirror the governance choices of the superior government. However, if the superior government continuously escalates penalties for negative supervision, it could stifle the departments' initiative and creativity in governance and limit the role of public participation in supervision. Comparing Fig.16 and Fig.13, it is evident that social evaluation and superior government punishment effectively motivate the educational department to fulfill its regulatory duties. However, the department exhibits significantly greater sensitivity to social reputation W than to the superior governments punishment Q.

Compared to schools, educational departments, regardless of their true intentions, appear to place considerable emphasisat least in outward formson feedback from the public or parents regarding students' schoolwork burden. As shown in Fig.18, schools' negative governance of students' schoolwork burden is actively addressed by educational departments. Moreover, the more concerns raised by the public or parents, or the more prominent the issue of schoolwork burden becomes, the faster educational departments transition toward positive supervision. The findings suggest that while the cautious stance of educational departments may not necessarily stem from willingness, they cannot allow the issue to escalate unchecked. Doing so could provoke public backlash or even lead to punitive actions from superior authorities. Consequently, addressing the identified problems becomes a rational choice for educational departments.

Providing incentives for schools to adopt positive governance strategies introduces additional benefits for schools while incurring costs for educational departments. As il-

lustrated in Fig.19, educational departments are willing to offer incentives to encourage schools to actively address the schoolwork burden issue. These incentives help reduce dissatisfaction among the public or parents and alleviate potential challenges for the departments themselves. However, such incentives (B) inevitably lead to increased regulatory costs. As the amount of incentives rises, the evolution rate of educational departments slows, underscoring the role of cost considerations in their strategic decision-making. Naturally, in favorable economic conditions with stable government tax revenues, educational departments face fewer financial constraints, reducing the influence of cost-related factors on their strategies. A similar effect is observed with N, as shown in Fig.20.

In this model, V represents the punishments imposed by educational departments on schools for negative governance. As depicted in Fig.21, the dynamics of V resemble those of B, with a key difference: V represents a cost for schools engaging in negative governance but serves as a revenue source for educational departments. Consequently, higher values of V increase the willingness of educational departments to enforce supervision, presenting a stark contrast to the scenario with B.

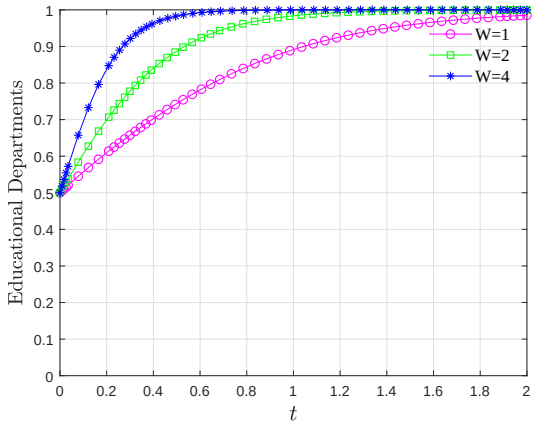

Fig. 16. The Impact of Social Reputation on the Educational Departments

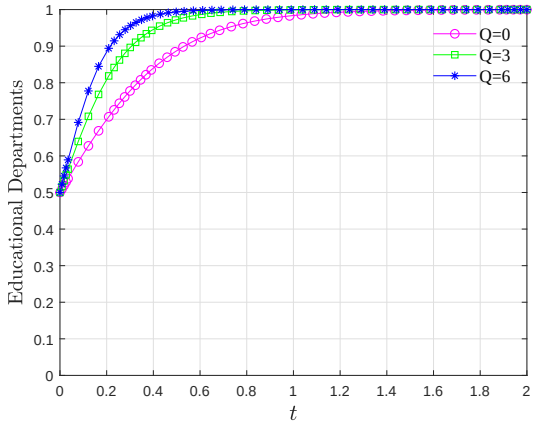

Fig. 17. The Impact of Superior Punishment on the Educational Departments

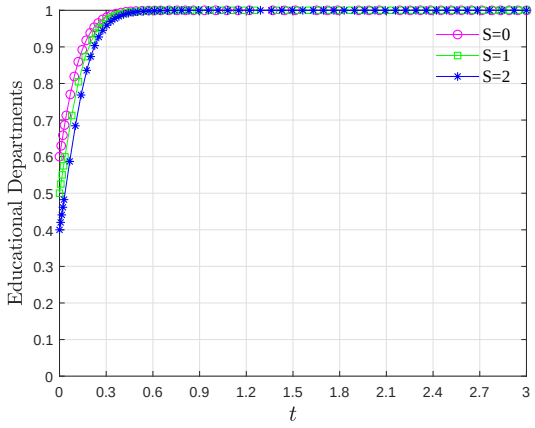

Fig. 18. The Impact on Loss of Students' Physical Health or Rest Time on the Educational Departments

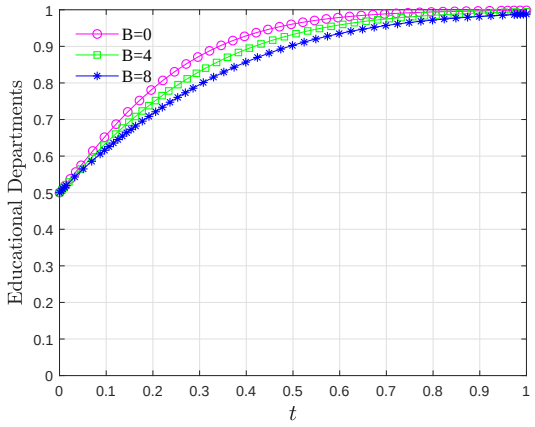

Fig. 19. The Impact of Incentives on the Educational Departments

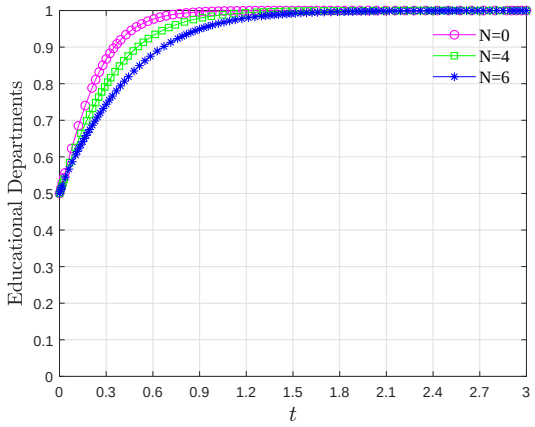

Fig. 20. The Impact of Rewards on the Educational Departments

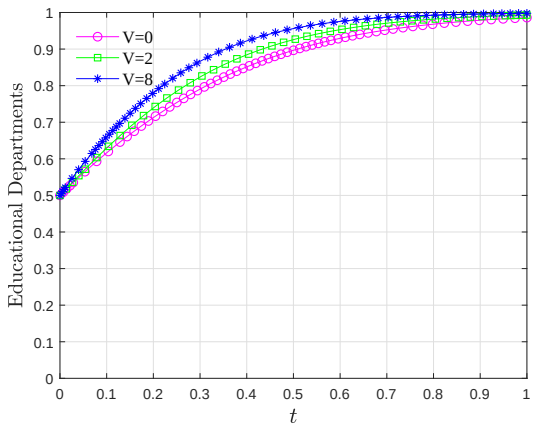

Fig. 21. The Impact of Punishment on the Educational Departments

VI. Conclusions and Prospects

The fundamental task of education in the new era is to cultivate individuals with ethical values, aiming to nurture socialist builders and successors with comprehensive development in morality, intellect, physical ability, aesthetics, and labor. Managing students' schoolwork burden under the "Double reduction" policy is a key method for fostering a positive educational environment, alleviating parental stress, and promoting holistic development and healthy growth among students. The interactive model integrates various stakeholders and developmental goals. Based on the simulation analysis of the public, schools, and educational departments, the following main conclusions and future directions are summarized:

1) Collaborative governance through stakeholder engagement: The public should articulate their governance demands reasonably. Schools and teachers must acknowledge, embrace, and enhance these demands. Educational departments should adopt a scientific approach to formulating governance policies, fulfill their regulatory responsibilities, and ensure effective channels for social supervision. The news media should also be guided by public opinion. Achieving the optimal state of tripartite collaborative governance over students' schoolwork burden depends on active participation from all stakeholders, with schools playing a critical role. The analysis of $E_3(1,0,1)$, $E_6(1,0,1)$, $E_7(0,1,1)$, and $E_8(1,1,1)$ demonstrates that only by mobilizing schools' enthusiasm for positive governance can collaborative governance achieve stability. Without this, the goal of effective tripartite governance cannot be realized.

2) The persistent and widespread nature of schoolwork burden issues: Excessive schoolwork burden primarily affects students' physical health and rest time, which are top concerns for parents but often secondary considerations for schools and educational departments. Governance actions by schools or educational departments tend to occur only when the problem becomes severe or attracts the attention of higher-level authorities. This finding underscores the widespread prevalence of schoolwork burden issues in China and suggests that addressing this challenge will be a long-term process.

3) Public priorities and strategic responses: The rewards provided by educational departments and the effectiveness of schoolwork burden management significantly influence the public's strategic responses, shaping the evolution of governance strategies. As direct witnesses to the impact of schoolwork burdens, the public (mainly parents) place greater importance on the governments' governance stance and supervisory measures than on material incentives offered by educational departments. It is essential to address parents' and students' concerns promptly and effectively, avoiding perfunctory or superficial actions. Schools are expected to heed public queries and feedback while steadily improving the management of schoolwork burdens.

4) Schools' strategic choices and their influencing factors: Schools' strategic decisions are primarily influenced by their social reputation, along with the rewards and punishments administered by educational departments. Among these factors, social reputation exerts the most significant impact, while punishments are more influential than rewards. Schools tend to respond more sensitively to penalties imposed by educational departments than to incentives. To improve governance outcomes, educational departments should broaden public participation in supervision, promptly address and resolve critical issues, and enhance evaluation methods for educational practices. Additionally, optimizing the effectiveness evaluation index system for school operations can lower daily supervision costs, encourage schools to take the initiative in governance, and improve overall governance effectiveness.

5) The regulatory priorities and strategies of educational departments: Educational departments prioritize not only the evaluation results from superior governments but also aim to optimize outcomes for local primary and secondary schools within the constraints of existing resources. Moreover, they seek to prevent schoolwork burden issues from escalating into widespread public controversies. Compared to punishments imposed by superior governments for regulatory failures, the influence of social reputation and the broader image of education holds greater significance in shaping the regulatory strategies of educational departments. Superior governments can enhance these efforts by strengthening the supervision of educational quality across regions through comprehensive assessments and evaluations, releasing exemplary cases to establish a deterrent effect, and ensuring local educational departments fulfill their responsibilities. Incorporating feedback from the public and parents into the assessment of local educational departments is also critical for achieving more scientifically robust and precise evaluation outcomes, thereby improving the overall effectiveness of collaborative governance.

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