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"Teacher-Student-University": A Three-Party Game in China Higher Education

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Abstract

Teaching process monitoring and effectiveness evaluation is the core part of higher education management, which is the most important guarantee to maintain the normal teaching order and effectiveness of higher education institutions and ensure students' rights and interests. According to the three-party game model of "Teacher-Student-University", the willingness of teachers to enforce the teaching regulations and the motivation of collusion with students are influenced by the cost of supervision and punishment of the university. The university can invest more in institutional costs, human capital etc., and strengthen the penalties, to enhance the motivation of teachers and students to take the teaching regulations seriously and improve the effectiveness of teaching.

Keywords: Higher Education Institute; Teaching; Three Party Game; Modeling

Introduction

Since the Ministry of Education of the People's Republic of China issued the "Action Plan for Revitalizing Education in the 21st Century" in 1999, with the expansion of higher education institutes (hereinafter referred as to HEIs), the number of college students in China has been increasing year by year. By 2002, the gross enrollment rate of higher education reached 15%, since then, higher education in China has entered the mass stage from the elite stage (Trow, 1973). By 2019, the gross enrollment rate of higher education has reached 50%, officially entering the universal stage. By 2021, the gross enrollment rate of higher education has reached 57.8% (2022). The surge in the number of students is accompanied by an increasing difficulty for teachers to teach. First, the teacher-student ratio exceeds the standard, making it difficult to carry out the teaching effectively. According to the data in 2021, released by the Ministry of Education, there are 47,034,600 students enrolled in university and colleges nationwide (including undergraduate, graduate, and online degree teaching). By only 1,885,200 full-time teachers in higher education, with a student-teacher ratio of 1:24.95, which is far below the standard of 1:18 issued by the Minister of Education. If we consider that the student-teacher ratio for graduate students is generally well below 1:18, the undergraduate student-teacher ratio in some HEIs exceeds 1:30; in some popular majors it even reaches 1:100. This brings difficulties and challenges to effective teaching. Secondly, some provisions of the teaching standard system documents are more abstract, and in the process of concrete implementation, there is more room for flexibility, which increases the difficulty of teachers' implementation. Especially for teachers at the grassroots level, abstract regulations often lead to confusion and contradictions in implementation, which is not conducive to the development of teaching and learning.

In the context of the universalization of higher education and the limited number of teachers, the implementation of teaching regulations by universities, teachers, and students' responses to them form a typical three-way game.

This paper focuses on modeling and solving the game from the perspective of "teacher-student-university" with respect to the daily rules and regulations of teaching and learning and proposes some feasible suggestions for schools based on the analysis results.

Methodology

HEIs are in an absolute position to regulate the teaching regulations, and they can regulate, monitor, handle and control the teaching standards that teachers must implement and the learning standards that students must achieve. For example, they can regulate the teacher's preparation for class, teaching routines, assessment criteria, and achievement of goals. As a regulator, the frequency and breadth of regulation and its effectiveness are strategic elements in the game (Dixit et al., 2014). In this paper, the university may use two strategies: regulation and non-regulation.

Teachers, as direct implementers of teaching regulations, have the right to micro-adjust (Gibbs & Coffey, 2004). The teacher may make small relaxations in a certain range, usually a particular course or a particular unit of assessment, depending on the actual situation. For example, teachers may adjust the frequency of sign-in roll calls, thereby raising or lowering the standards of instructional management. In this paper, teachers may use two strategies: strict enforcement of student management rules and lenient enforcement (with no enforcement) of instructional rules.

Students do not seem to have much decision-making power in the three-way game model. However, the strategies that students can adopt vary, with students adopting both strict compliance and non-compliance (individual behavior; collusion with teachers, use of deception and concealment, etc.).

Assumptions of the game model: One is that students, teachers, and universities are rational persons whose main goal is to maximize revenue; and two is that HEIs can completely monitor teachers' and students' implementation of the teaching regulations, i.e., the information is valid and comprehensive.

The basic gain for teachers is R_t and the input C_t is needed to strictly implement the student management system; the basic gain for students' compliance is R_s, the expected gain for non-compliance is R_s^* and the input is C_s; the gain for schools to strengthen the supervision of academic standards is R_u and the cost paid is C_u, and the penalty Z received by schools when teachers are found to abandon the implementation of teaching regulations and students' non-compliance with management regulations.

To simplify the model, based on the realistic situation, it is considered that teachers who abandon the implementation of teaching regulations are irresponsible to students and will face serious penalties if they are reported by students. Therefore, it is assumed that the teacher must reach a tacit agreement with the student on the relevant issues before deciding: in one case, the student does not conspire with the teacher to waive the enforcement of the teaching rules, i.e., if the teacher is irresponsible to the student, the student will report to the school. In the other case, the student agrees to conspire with the teacher to waive the rules, i.e., the student will not report the teacher's lax behavior. In this regard, suppose that the probability of teacher-student collusion in a school year is p, and the probability of school supervision of teachers and students is q.

Based on some actual phenomena in teaching, four possible scenarios are deduced.

The university does not have any special supervision, the teachers are consciously and strictly managed, and the students voluntarily comply with the rules. The benefits of the game for teachers, students and schools are $R_t - C_t, R_s - C_s, R_u$.

The school conducts strict quality control, the teachers conduct strict teaching management, and the students comply with the rules. At this point, the gains of the game among teachers, students and schools are $R_t - C_t, R_s - C_s, R_u - C_u$.

The teacher and the student conspire not to implement the teaching rules but are supervised by the school and punished. At this point the benefits of the game for the teacher, student and school are $R_t - Z, R_s^* - Z, R_u - C_u + Z$.

The school does not exercise strict supervision and teachers and students conspire not to enforce the rules. At this point the benefits of the three-way game between teachers, students and the school are R_t, R_s^*, 0. This leads to the payoff matrix of the three-way game between teachers, students, and schools, as shown in table 1.

Table 1. Tri-party game payoff matrix

Teacher and Student	**University**	
	Supervisory(q)	**No supervision (1−q)**
Collusion(p)	$(R_t - Z, R_s^* - Z, R_u - C_u + Z)$	$(R_t, R_s^*, 0)$
No Collusion $(1-p)$	$(R_t - C_t, R_s - C_s, R_u - C_u)$	$(R_t - C_t, R_s - C_s, R_u)$

Results

Based on the above payoff matrix, a repeated game with less than 8 times. The expected gain π_u for the school to be regulated and the expected gain without regulation $\pi_u^{'}$

$$\pi_u = [p(R_u - C_u + Z) + (1-p) * (R_u - C_u)] \sum_{i=0}^{8} \left(\frac{1}{1+r}\right)^t$$

$$\pi_u^{'} = [p * 0 + (1-p)R_u] \sum_{i=0}^{8} \left(\frac{1}{1+r}\right)^t$$

r represents investment income, $\left(\frac{1}{1+r}\right)^t$ denotes the discount factor at semester t.

When the expected benefits of schools regulating and not regulating whether teachers strictly enforce teaching regulations are equal, p satisfies,

$$p = p_1^* = \frac{C_u}{R_u + Z} \quad (1)$$

For teachers, their expected gains π_t from forgoing implementation of the teaching regulations and expected gains $\pi_t^{'}$ from strict implementation of the regulations are.

$$\pi_t = [q(R_t - Z) + (1-q)R_t] \sum_{i=0}^{8} \left(\frac{1}{1+r}\right)^t$$

$$\pi_t^{'} = [q(R_t - Z) + (1-q)(R_t - C_t)] \sum_{i=0}^{8} \left(\frac{1}{1+r}\right)^t$$

When the expected gain π_t from teachers forgoing enforcement of the instructional regulations and the expected gain $\pi_t^{'}$, from strict enforcement are equal, then q satisfies.

$$q = q_1^* = \frac{C_t}{R_t + Z} \quad (2)$$

For students, their expected benefits π_s for non−compliance with student management regulations and expected benefits $\pi_s^{'}$ for strict compliance with instructional regulations are,

$$\pi_s = [q(R_s^* - Z) + (1-q)R_s] \sum_{i=0}^{8} \left(\frac{1}{1+r}\right)^t$$

$$\pi_s^{'} = [q(R_s^* - Z) + (1-q)(R_s - C_s)] \sum_{i=0}^{8} \left(\frac{1}{1+r}\right)^t$$

When the expected benefit π_s of student non−compliance with student regulations and the expected benefit $\pi_s^{'}$ of strict compliance with student regulations are equal, it is only necessary to satisfy,

$$q_1^* = C_s \qquad (3)$$

According to equation (1)(2)(3), the Nash equilibrium of the mixed game model of "teacher-student-university" is

$$p = p_1^* = \frac{C_u}{R_u + Z}, \qquad q = q_1^* = \frac{C_t}{R_t + Z}, \qquad q_1^* = C_s$$

Discussion

From the above results, it is clear that the probability p of teachers and students conspiring not to implement teaching regulations is positively proportional to the school's supervision cost C_u and inversely proportional to the penalty Z received for being detected. Clearly, when the cost of school supervision C_u is higher, the more likely the school will choose to drop or reduce supervision, which in turn inversely promotes the incentive for teachers and students to conspire not to enforce the instructional rules. On the other hand, if the penalty Z received for being caught is more severe, the incentive for counselors and students to collude is reduced.

Conclusion

A range of measures are needed to increase the motivation of both teachers and students to take student management rules seriously.

Establish clear and unambiguous teaching and learning regulations. Schools must establish clear and unambiguous teaching and learning regulations with quantifiable targets wherever possible to reduce the flexibility of implementation.

Encourage teaching and student participation in the development of teaching and learning regulations. To ensure the enforceability and effectiveness of teaching and learning regulations, teachers and students should be encouraged to participate in the development of teaching and learning regulations. Instructional regulations that are not enforceable and effective are bound to be resisted by faculty and students and promote incentives for faculty and students to collude. Instructional regulations that are too stringent or unrealistic for teachers to ensure that the relevant goals are met will naturally be abandoned. But a realistic academic standard, through other motivational means, will be fully enforced by teachers. And the effectiveness of teaching regulations is reflected in the ultimate benefits to students, who will support them if they can gain enough by strictly regulating their own learning behavior.

Increase the rewards for academically outstanding students and their teachers. One of the feasible approaches is to reward students with excellent academic performance. In practice, the establishment of scholarships, the selection of outstanding students and outstanding graduates does have the effect of promoting students to strictly regulate their own learning behavior. In addition, establishing a scientific, reasonable, and effective performance appraisal system for teachers and linking the implementation of teaching regulations with teachers' rewards will also significantly improve teachers' work motivation.

Increase the management and punishment of falsification. Based on the assumption of rational human, when the risk of loss and gain is large enough, rational people will choose the strategy that is most beneficial to them. As mentioned earlier, strengthening regulation, and increasing penalties will effectively reduce the possibility of collusion between teachers and students. When the benefits of carefully enforcing instructional regulations are large enough and the potential penalties for collusion are large enough, teachers and students will abandon collusion and instead devote themselves to adhering to academic standards.

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