Game Theoretical Analysis of Educational Situation in China

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Abstract. The development of “quality-oriented education” (suzhi jiaoyu) has been a hotly debated issue in China in recent years. Many government policies are formulated to guide and hasten the development of this new form of education. Despite support and propaganda from the government, “quality-oriented education” did not reach expected success, only achieving limited recognition. It will be the focus of this paper to delve into the existing educational situation in China and examine the interest web impeding the popularization of “quality-oriented education” via game theory. In the end, the paper will seek to provide certain solutions to the dilemma through game theoretical analysis.

Introduction

As is known, China is a country of unbalanced allocation of resources and partially unfair educational systems. Therefore, ever since “quality-oriented education” (QOE) was officially proposed as the core principle of education in China in 1990s, there has been a series of propaganda for a change in educational methods and testing systems. However, the collective efforts of government, schools, and students didn’t yield the expected result: it finds a contradictory mix of subjectifying rhetoric and practice in China’s classroom[1]. Schools always tend to find a shortcut to full implement, and many parents have difficulty changing their minds as well[2].

Despite these setbacks, the benefits of “quality-oriented education” have long been recognized, especially in comparison to the traditional system, which has long been criticized as primarily focusing on testing and scores. Also, under such institutions students are forced to participate in an intensive amount of extra-curriculum classes or private supplementary tutoring. Several researchers have analyzed the motivation behind the craze for extra classes from the perspective of economic costs and family burden[3-5]. Therefore, the reason of the failure to popularize “quality-oriented education” is complicated. The principal hindrance to widespread acceptance of “quality-oriented education” is unbalanced development between the educational system and testing system. Without corresponding testing mechanisms, there will never be enough incentive for the popularization of the new system.

Luckily, in recent years, there has been the emergence of a new kind of admission policy — the “independent recruitment” (zizhu zhaosheng). Its biggest distinction from “gaokao”, the traditional admission process, is that it puts more focus on the overall ability of a student instead of mere academic achievements. Gaining popularity throughout the years, “independent recruitment” has become a major attraction for many students whose scores are high but not enough to ensure acceptance into top universities. Although still not enough to shake the ingrained notion of “score determines future” in many Chinese people’s hearts, it is definitely a positive signal.

In the following sections, the future of “quality-oriented education” will be discussed from two perspectives: the reality where alternative testing is sill inadequate, and the prospect where innovative testing has the vantage point. Basic game theory logic and mathematics will be utilized to fully demonstrate the thinking of multiple subjects and its effects on the progression of “quality-oriented education”.
Strategic Thinking for Parents/Students

Nowadays, the typical Chinese family still treat squeezing into the local top schools as the first priority\[6\]. Despite their conjunct dissatisfaction for “test-oriented education” (TOE), most parents still force their kids into it in reality. The following analysis demonstrates the reason.

Each household has a decision to make: whether to take many extra-curriculum classes and maximize the kid’s test scores or to allow him/her to spend time developing specialties and improving quality. The result for each strategy set is represented as ordinal payoffs. (F1 is treated as a group of households and F2 as another because in real life, the actions of just two households will be too puny to have any visible impact). The process of decision-making is visualized in Table 1.

Table 1. Strategic thinking for parents/students modelled as the prisoners’ dilemma.

<table>
<thead>
<tr>
<th></th>
<th>TOE (F1)</th>
<th>QOE (F1)</th>
</tr>
</thead>
<tbody>
<tr>
<td>TOE (F2)</td>
<td>6,6</td>
<td>8,2</td>
</tr>
<tr>
<td>QOE (F2)</td>
<td>2,8</td>
<td>4,4</td>
</tr>
</tbody>
</table>

The situation above can easily be modelled as a Prisoners’ Dilemma\[7\], in which each individual acting towards their own interest (taking extra-curriculum classes) yields a result nonoptimal for the whole society (no one both receives quality education and squeezes into top schools).

However, most parents still choose to comply with their self-interest. The reason behind such choices is obvious: no one would like to end up with a payoff of “2”, so it would be best to follow other people’s lead. Analogous to the herd mentality in psychology, such trends essentially clog innovation and revolution.

Strategic Thinking for School

Unlike parents, who may have concern for the overall development of their children, schools typically have only one index for their success: enrollment rates, or in other words, the scores of their graduates. As a result, many schools would do whatever it takes to ensure high average scores. It is fairly common among Chinese schools, especially the less well known ones, to cancel “side classes” such as music and arts and replace them with the “main courses”.

Under such circumstances, the outcome would be obvious if “gaokao” is the only method for selection: just like the previous discussion on the parents’ strategic thinking, it would be each entity’s primary goal to fully exploit the potential of “test-oriented education”. Therefore, we will omit the analysis and come straight to the point: in most cities, applying “test-oriented education” would still be the undoubted best decision.

Luckily, government officials and scholars have realized this and for the past decade, much work has been done to incentivize participation in “side classes” and cultivation of interdisciplinary abilities. Among them, the “independent recruitment” has been the most prominent and pervasive. Such assessments demand the students’ demonstration of all-round aptitudes, which fits more closely to the aim of “quality-oriented education”. In some regions, especially large cities, their impact can be seen clearly in the shift of core educational standards. However, such is only the privilege of the privileged. Even in most second and third tier cities, the effect of “independent recruitment” can still be ignored. In their infancy, these alternative testing methods are still lacking in proper organization and management. In the following analysis, it will be a premise that alternative testing systems exist.

Analysis of Competition When Quality Education Exists (Closely Contested Version)

As mentioned above, there are certain metropolis where alternative assessments are regularly issued with appropriate management. Let’s first consider the case where two closely contested schools compete. In this case, resource distribution is considered equal between the two schools and when their strategies are identical they split the student pool.

Under such assumptions, the following normal form can be drawn up, as shown in Table 2, for the competition between the two schools S1 and S2.

```plaintext
<table>
<thead>
<tr>
<th>S1</th>
<th>TOE</th>
<th>QOE</th>
</tr>
</thead>
<tbody>
<tr>
<td>TOE</td>
<td>6,6</td>
<td>8,2</td>
</tr>
<tr>
<td>QOE</td>
<td>2,8</td>
<td>4,4</td>
</tr>
</tbody>
</table>
```
Table 2. Normal form of competition when schools are closely contested.

<table>
<thead>
<tr>
<th></th>
<th>TOE (S2)</th>
<th>QOE (S2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>TOE (S1)</td>
<td>A1,A1</td>
<td>A3,A4+B1</td>
</tr>
<tr>
<td>QOE (S1)</td>
<td>A4+B1,A3</td>
<td>A2+B2,A2+B2</td>
</tr>
</tbody>
</table>

The B’s stand for payoff gained from the alternative testing methods. When the proportion of “QOE” is relatively small, B1 and B2 would also be relatively small, so the loss of payoff caused by less focus on testing cannot be effectively covered by gains from alternative testing, which can be represented mathematically as A4+B1<A1 and A2+B2<A3. From here, it will be easy to spot the Nash Equilibrium—where both players pick TOE (again!).

However, if the portion of alternative testing could be increased by a remarkable percentage, which indicates that B1 and B2 would not be marginal, then they might be large enough that A2+B2>A3 and A4+B1>A1, meaning the Nash Equilibrium has changed to the action set where both players pick QOE—our most favored outcome!

To conclude, when two schools parallel in power, the only way to stimulate them into stably and willingly picking “quality-oriented education” would be to increase the proportion of alternative tests to a significant extent. However, that would require much regulation and management by the government and the active corporation of the schools.

Mathematical Proof to the Improbability of Pervasive QOE

The improbability of wide-spread use of “quality-oriented education” can also be demonstrated mathematically. Suppose there are only two schools in a city, No.1 and No.2. Each can choose its balance between “QOE” and “TOE”. At the beginning, when all their resource is devoted to TOE, each school consists of 1000 students and has a reputation of 50 points. With each hundredth it devotes to QOE, the school loses 5 students but receives a one point bonus to their reputation. When there’s difference between the two school’s balance of strategies, the one with the lower percentage of QOE takes away one student from the other for each hundredth’s difference. Table 3 elaborates the setting above.

Table 3. Each school’s devotion in QOE.

<table>
<thead>
<tr>
<th></th>
<th>No.1</th>
<th>No.2</th>
</tr>
</thead>
<tbody>
<tr>
<td>QOE</td>
<td>A%</td>
<td>C%</td>
</tr>
<tr>
<td>TOE</td>
<td>B%</td>
<td>D%</td>
</tr>
</tbody>
</table>

Note: No.1 school’s total amount of students: 1000-5A-(A-C);
No.2 school’s total amount of students: 1000-5C+(A-C)

The method of evaluation would be to multiply the number of students in each school by its reputation points.

Therefore, the result for No.1 school would be (1000-6A+C)(50+A), while the result for No.2 school would be (1000-6C+A)(50+C)

Maximizing each school’s total points, we yield the solution that the Nash Equilibrium can only be reached when A=C=63.6, which is basically impossible to achieve under the circumstances.

Suppose the average quality of Chinese citizens has raised and now people care more about QOE than ever before. In this case, parameters in the previous example need to be reassigned. Suppose now a 1% increase in QOE will only result in the loss of one student while resulting in the acquirement of 5 reputation points. As we redo our calculation, it turns out that now we only need A (and C) to be 36.9 to achieve the Nash Equilibrium, which is much more realistic.

This example shows how improving the average quality of Chinese citizens can in effect promote the implement of “quality-oriented education”. Therefore, it becomes necessary that we strive to help every citizen better perceive the world. Indeed, that would take much effort and time, and would require the active involvement of every citizen.
Analysis of Competition When Quality Education Exists (Vastly Unbalanced Version)

The final example would be in regards to an exceptional situation when resources between two schools are extremely unbalanced. In this setting, when two schools pick the same strategy their respective payoffs will still be in great disparity. The following normal form demonstrates the situation.

Table 4. Normal form of competition when unbalance of resources is severe.

<table>
<thead>
<tr>
<th></th>
<th>TOE (S2)</th>
<th>QOE (S2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>TOE (S1)</td>
<td>80,20</td>
<td>50,50</td>
</tr>
<tr>
<td>QOE (S1)</td>
<td>70,30</td>
<td>60,40</td>
</tr>
</tbody>
</table>

Note: S1 represents the big school holding most of the resources  
S2 represents the oppressed small school

The reasoning behind these numbers is as follows: due to the vastly unbalanced distribution of resources, even when S1 switches to TOE, S2 would still acquire a relatively small number of payoff. However, if S2 switches to QOE, then it would have noteworthy advantage in the alternative tests, obtaining a significant increase in payoff. When both schools pursue QOE, S2, the smaller school, will be repressed again, resulting in a slight decrease in payoff.

The Nash equilibrium for the game above is when both schools pick QOE, which is our most preferred outcome. As is proven, in the extreme case where the unbalance of the allocation of resources is awfully severe, there might be a change over the school’s strategies. The smaller school might be willing to propagate “quality-oriented education” to ensure its survival. Under the circumstances that seems to be the only situation where “quality-oriented education” will be appreciated.

Summary

Despite the fact that unbalanced distribution of resources is serious and ingrained at present in China, it is not an unsolvable problem. As the Game Theory analysis shows, with a fundamental change in the educational structure and a significant improvement in the overall quality of civilians, revolution is still possible, if not probable. Now the hard part is to bring about the necessary changes. Men are all selfish and reminiscent. Therefore, it would be literally impossible to rely solely on each citizen’s own conscience. Government legislations and administrations are essential. Fortunately in recent years there have been a number of new laws specifically devoted to the generalization of alternative testing methods and “quality-oriented education”. Their effects remain to be seen, but indeed we are moving in the right direction.

What’s more, regulative branches must also take adequate action in reinforcing the testified legislations. Regular inspections should be normality, along with clear lines delineating violations and reasonable yet effective punishment for them.

Relatively, government restriction is the easy part. The harder yet ultimately more meaningful approach — to provide the average citizen with deeper insights into education — would take far more than plain enactment of laws. As it is rather a pedagogic problem, it will not be analyzed closely for now. However, one thing is for certain: it would take the collective effort of generations, and no matter what happens, everyone is on the same boat.

References


