Educational Psychology Analysis Based on Dynamic Game Model

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Abstract

Accurately grasp students' mental, is essential to achieve expected teaching objectives. From the psychological point of view, the behavior of students is generally bounded rationality, and its decisions are often influenced by other students. In this paper, make student as the research content, dynamic game model was constructed based on game theory to analyze whether herding effect swill occur in the process of student enrollment. In the model, investigated exchange proceeds, exchanges scope, cost factors and other conditions in student exchange process. Experimental results show that exchange proceeds is the most important factor to determine whether the student elective behavior will occur herding effect, in addition to the exchange scope, cost factors also have some influence on whether students form a herd mentality.

Keywords: Educational psychology; Dynamic game model; Student enrolment; Herd behavior

1 Introduction

Education is a great and arduous task. If we really want to improve education, we must t full advantage of inner thoughts, interests and needs of educates. When combined with education and psychology, a new field of science along with it was born, this is the educational psychology.

From a psychological point of view to enhance teaching effectiveness whether it is meaningful, research of scholars, mainly conduct from the theoretical aspects. Gail investigated the effect of psychological factors on teaching, he believes that the positive psychological excitation t will increase students' confidence in improving the teaching achievement, which is conducive to better achieve the desired objectives [1]. Gan pointed out that in process of teaching the psychological of students will be affected from both positive and negative directions, and is a shift in the relationship between the two, when the improvement of student achievement will improve self-confidence, when student achievement drops, the mood will become frustrated, teaching methods should be developed in accordance with changes in the student reasonable mood. Nancy believes that the teaching process must be closely integrated with children's psychological, for different students grasp the psychological changes in different periods, is the key to reach the expected goal of teaching [2]. Friesz found that students in the teaching process depend largely on the behavior of a series of children's psychological state, and students affected by mental psychological maturity often irrational [3].

In order to make the research findings of educational psychology more scientific and credibility, scholars have also opened up the way to empirical research based on mathematical models. Friesz made the students learning process as a multi-objective optimization problem, and accordingly established a mathematical model to optimize control, in fact, conclusions displays students' psychological changes are with the adjustment of each target varies. Comin think a lot of students showed significant herding behavior, which is characterized by herd mentality in student performance.

In this paper, using undergraduate student enrollment this particular learning behavior as a starting point to construct a mathematical model based on dynamic game theory, in order to explore whether there is a herd mentality of students in the learning process.

2 Construction of dynamic game model of student enrolment

2.1 GAME MODEL DESIGN STUDENT ELECTIVE

Many courses are electives among colleges and universities, students have freedom of chosen this course and do not choose this course. In a class or a grade, part of the students have a clear understanding of the courses information, and has a clear learning objectives; another part of the students do not understand the information on this program, there is no clear learning objectives. We can put the former is defined as "insiders", which is defined as "uninformed." Thus, the enrollment process becomes a game behavior between insiders and insiders, insiders and non-insiders, not-insiders and non-insiders.

At the beginning of each semester, students are faced with the question of how TO enrollment. Assuming that each student will form a view, in order to facilitate subsequent analysis, assuming that any viewpoint $i \in [0,1]$. The final enrollment decision-making behavior of students can be divided into autonomous decision-making and follow others,

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these two behaviors expressed by U and V respectively.

Further analysis shows that to select the independent decision behavior of U, is bound to analyze the relevant information of new courses in order to form decision close to the expected. Students of U type behavior can be obtained exchange proceeds R_A and analysis proceeds R_A in the exchange process with other types students. However, also takes some analysis cost C, such as time. Choose follow from V types behavior of others, there is no analysis cost inputs, the analysis will not be able to get proceeds, but can be exchange with student Class U behaviors, to get the exchange earnings R_E.

For communication process of two students, there are four cases. When the student of U class acts exchange with students of U class acts, you can get analyze gains and double exchange gains, but need to pay the cost of analysis; when the student of U acts exchange with students of V class act, students of U type acts can get analyze income and exchange gains, but need to pay the cost analysis, acts of class V students can get exchange gains; when students of V class acts exchange with students of V class acts, the two students had no income.

From the student perspective, select the new courses is designed to learn knowledge they want to learn, when they have confidence in themselves decision-making will take V class act, when they have no confidence in themselves decision-making will take V class behavior. Assumes that the probability of all students choose V class behavior is p, then the probability of selecting U class behaviors is $1-p$. Accordingly, choose U class behaviors can obtain the expected return is calculated as shown in Equation (1).

$$\begin{aligned} E_U &= p(R_E + R_A - C) + (1-p)(2R_E + R_A - C) \\ &= (1-p)\,R_E + R_E + R_A - C \end{aligned} \tag{1}$$

Choose V lass behaviors can obtain the expected return is calculated as shown in Equation(2).

$$\begin{aligned} E_V &= p \times 0 + (1-p)R_E \\ &= (1-p)\,R_E \end{aligned} \tag{2}$$

Specific to an individual student, its choose sole discretion behavior of U or to follow others' behavior of V, is actually a differences problem to compare expectations of U class behavior and V class behavior available to obtain desired, this difference is defined as ΔE, the size of ΔE show as equation (3) below.

$$\begin{aligned} \Delta E &= E_U - E_V \\ &= R_E + R_A - C \end{aligned} \tag{3}$$

When $\Delta E < 0$, students will generally follow the actions of others to select courses to study; When $\Delta E > 0$, students will generally make their own decisions to select courses to study; When $\Delta E = 0$, students will be randomly selected U behavior and V behavior .

From equation (3) can be seen, when analysis income R_A is greater than the cost of analysis C, ΔE is larger than 0 forever, the students follow the actions of others does not appear. Of course, this is just an ideal situation. In practice, the students will not only appear to follow the actions of others, but also a high proportion to follow others, it also shows that students are restricted to its own conditions, and the cost of analysis is often higher than income.

2.2 DYNAMIC PROPAGATION MODEL STUDENT ENROLLMENT DESIONS

Hypothesis student population doing enrollment decisions contains a total of X students, selected to follow the V behavior of others in groups, the proportion n is a time-varying variable, changing with time t, m is changing, the average expected income of groups are changing, such as (4) shown in the formula.

$$\begin{aligned} \overline{E} &= (1-n)E_U + E_V \\ &= (1-n)(R_E + R_A - C) + (1-m)R_E \end{aligned} \tag{4}$$

Then, dynamic changes of the proportion of individual students select to follow the behavior of others, can be described by the following model.

$$\begin{aligned} \frac{dn}{dt} &= n(E_V - \overline{E}) \\ &= -n(1-n)(R_E + R_A - C) \\ &= -n(1-n)\Delta E \end{aligned} \tag{5}$$

For dynamic changes equation as shown in equation (5), it's steady state of more concern, that is, stable proportion of groups of students in the decision-making process to choose elective themselves and follow others to select, which is the key to portrayed the herding degree of student groups.

The stability of the variable n, the case that is n does not change, i.e., $dn/dt = 0$.

According to the formula (5), the dynamic changes of the proportion of group decision-making behavior in students is directly related with ΔE. If $\Delta E = 0$, $dn/dt = 0$ established forever, that is autonomous decision-making and follow others making no difference in the expected return, any ratio of n of group behavior is normal; If $\Delta E > 0$, $dn/dt \le 0$, and only when the $n = 0$ or $n = 1$, $dn/dt = 0$ is only established, but according to the definition of ΔE, $\Delta E > 0$ showed a greater expected return of autonomous decision-making, so $n = 0$ such that $dn/dt = 0$ was founded more in line with the actual situation, namely all individual students in policy of autonomy decisions; If $\Delta E < 0$, $dn/dt \ge 0$, only if $n = 0$ or $n = 1$, $dn/dt = 0$ is only established, but according to the definition of ΔE, $\Delta E < 0$ showed greater gains expected to follow decisions of others, so $n = 1$ make $dn/dt = 0$ established more comply realistic situation in which individual students all use others following policy to decisions, which is the deepest herding situation.

Correspond to any students view $i \in [0,1]$ the foregoing assumes that, in fact, only two students' individual views i and i'E are different, exchange of information is meaningful between two students, but the difference between i and i' are also not too large, otherwise the possibility of a consensus between the two students will be greatly reduced.

Thus, with a distance range of ε to define the difference as (6) formula.

$$|i - i'| < \varepsilon \tag{6}$$

Two individual students through the exchange, changes of their views can be described by the following equation:

$$\begin{cases} i = i + \theta(i' - i) \\ i' = i' + \theta(i - i') \end{cases} \quad (7)$$

Here, θ is regulation factor generated by the exchange of students. Then $\theta = 0$, two students will retain their views, indicating the exchange did not play a regulatory role; When $\theta = 0.5$, two students will reach full consensus, new ideas is the mean of two old ideas; when $\theta = 1$, the two students will appear views interchangeable situation, of course, this rarely happens in practice.

Visible, θ for different types of student groups, the value is not the same. For more stubborn student population, the value of θ can be as small as possible, for student groups easier to accept the views of others, the value of θ to be as large as possible.

3 Experimental analysis of herding in student enrollment status

Front, from a psychological point of view, to build a game model and dynamic propagation model of students elective. Now, as a basis to start experimental research to do experimental verification on the constructed model.

3.1 IMPACT ON STUDENT EXCHANGE GAINS ELECTIVES DECISION MAKING

In order to facilitate the experimental study of the dissemination model and game model to expand, the first to set the initial conditions of the simulation process, assuming that the number of students is $X = 30$, the simulation time is $t = 10$ nodes, communication cost is $C = 0.55$, regulating factor of $\theta = 0.5$ when student exchanges, student exchanges range is set to $S = 6$, that is, each farmer and six other students can communicate. Following study exchange gains R_E were four kinds of different situations when the student enrollment decisions affected the results shown in Table 1.

TABLE 1 When exchange gains changes, situation of student enrollment decisions

X	t	R_E	θ	S	The number of decisions	Convergence time
30	10	2.2	0.5	6	6	——
30	10	1.6	0.5	6	3	——
30	10	1.0	0.5	6	1	6
30	10	0.6	0.5	6	1	4

As can be seen from the results in Table 1, with the change of exchange gains R_E, the enrollment results of 30 students has undergone significant changes. When R_E is 2.2, 1.6 of exchange gains, the final enrollment decisions were 6 and 3, there is no herding; when exchange gains R_E is 1.0 and 0.6, the final elective decisions are 1, indicating the formation of herding.

In addition, when R_E is 1.0, convergence time to form a elective decision of 30 students is 6, when R_E is 0.6, convergence time of 30 students to form an elective decision is 4.

In order to facilitate visual observation of the above results, we plotted the above experiment, shown in Figure 1.

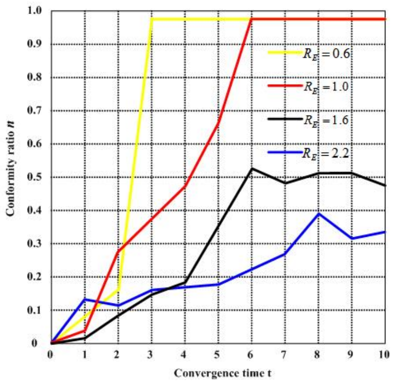

FIGURE 1 Convergence time and the proportion of the herd of four experiments

As can be seen from Figure 1 that comparison situation of curve 4, and the proportion corresponding to curves in both cases of the exchange proceeds $R_E = 0.6$ and $R_E = 1.0$ close to 100%, the convergence time is respect corresponding to the three time units and six units of time, this is consistent with the results of herding of the final two sets of experiments showed that the decision. The curve of both cases that exchange earnings $R_E = 1.6$ and $R_E = 2.2$ corresponding to the proportion of the herd were 47% and 33%.

3.2 EFFECT OF EXCHANGE RANGE ON STUDENT ENROLLMENT DECISIONS

Here, for further study effect of exchange range on student enrollment decisions. Assuming the number of students is $X = 30$, the simulation time nodes are $t = 10$, adjustment factor of $\theta = 0.5$ when students exchange. In order to meet this 30 student decision-making behavior can produce herding, set fixed exchange earnings of $R_E = 1.0$, the level of exchange costs from 0.5 to 1.5 C continues to increase, the AC range S, respectively at the situation of 5,6,7 next, changes of the time convergent nodes of the behavior of multi student enrollment decisions shown in Figure 2.

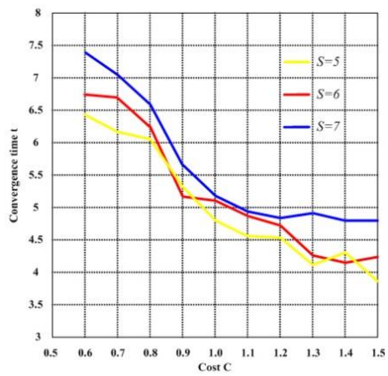

FIGURE 2. Impact of AC scope and exchange cost on convergence time

From overall performance of curve in Figure 2, regardless of student exchanges range is large or small, with the increasing cost of exchange, student exchanges gains under the circumstances remain unchanged, revenue obtained through individual analysis will continue to decline, resulting in a greater likelihood tend to blind obedience, the convergence speed to occur herding is faster.

4 Conclusion

In summary, you can get relevant conclusions of decision-making behavior in student elective :

Student as individuals in psychology with bounded rationality, in elective decision-making process, will be affected from other students, that herding impact can be achieved the level to change the original decision- making.

Exchange gains is an important factor to decided whether decision-making behavior of students will occur herding, when the exchange gains large enough, students can gain sufficient knowledge and experience of autonomous decision-making through the exchange gains, due to blindly follow the herd behavior generated does not occur; when the exchange gains very small, herd behavior might be happen only, and with decreasing of exchange gains, the formation rate of herd behavior is also accelerating.

Exchange scope and exchange costs also have important implications for students' decision-making behavior, exchange cost increasing will lead to the likelihood of herd behavior and convergence speed increases. Expand the scope of exchange, will lead to the likelihood of herd behavior to reduce and convergence slows down.

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