Playing Is Believing: Teaching How Electoral Systems Change Political Outcomes Using a Role-playing Simulation Game

December 30, 2017

Abstract

We propose a new role-playing game to teach the effects of electoral systems on politicians' preference and behavior. Because the electoral system is of great importance as a cause of various political outcomes, we political scientists should make sure that students understand what it is and why it could have consequential impacts on politics. However, we often fail to effectively teach the political importance of the electoral systems because of some weaknesses in the traditional, didactic teaching method. To improve political science education, we develop a game in which students can learn how electoral systems affect politician's behavior by playing a role of an electoral candidate. Our experiment shows that the game could be an effective supporting material to the lectures about the impacts of electoral systems. Our game is an addition to the repertoire of active-learning in political science.

Elections are essential for modern representative democracy. Democracy cannot be sustained without elections in advanced industrial societies. Even with them, democracy could malfunction if elections are corrupt or arbitrarily manipulated. Citizens living in democracies are expected to monitor democratic elections. For this purpose, we need to learn how elections work and how they affect political outcomes. Thus, we political scientists are required to teach our students about elections in order to enable them to understand the world better and help them become good citizens.

However, it is not hassle-free for students to learn electoral processes. There are a variety of electoral systems, and different systems generate different political outcomes. While some systems encourage more candidates to run for an election, some other systems discourage possible candidates and reduce the number of runners. Multiple candidates win a seat in a district under some rules, but only one gets a set under another. Some systems allow the voters to write a candidate's name on the ballot, but some others require voters to choose a political party from the list. Voters cast a single ballot in a district under some electoral systems, while they have a chance to vote for more than one candidates or parties in a district under the other. In short, electoral systems change the behavior of both candidates and voters in elections. It is painstaking for students to marshal which electoral systems lead to which outcomes.

Teachers can list several electoral systems and discuss the characteristics of each system in class, but it might be boring for students because a large portion of the students tend to think the most of the systems are irrelevant for them. Most Japanese students do not care about the French electoral system, for instance. Even worse, many students are not interested in the electoral system of their own country either, partly because they have never voted. In Japan, which we pick out as our case in this paper, the voting age was 20 until the lower house election in 2014.[1] Since most students enter a college at the age of 18 or 19, the vast majority of a class does not have a direct experience of elections when we teach electoral systems.[2] Therefore, we need to devise an easy and fun way to teach the electoral systems to make students understand them better.

In this paper, we propose a new method of teaching the effects of electoral systems on political outcomes using a role-playing game. This game focuses on the effect of district magnitude on candidate's political behavior. Students play a role of an electoral candidate and aim for electoral victories. By experiencing the thought process of electoral candidates, the students learn how the rule of the game shapes the incentive of political actors. By simulating two different sets of the electoral rules, it helps the students understand how important it is to compare multiple electoral systems. As is often the case with a gaming method, playing our game is more fun than listening to a lecture or reading a textbook.

The rest of this paper proceeds as follows. In the next section, we explain why it is important *and* difficult to teach electoral systems to college students by a traditional method of teaching. Next, we propose a new gaming method in Section . After introducing the game design, we show our expectation about the game results. We present the results of the game played by students and discuss the difference between the expected and observed results. Then, Section evaluates the effects of our game. We show that our method improves the students' understanding of the electoral systems, though the effect seems to be small. Finally, Section concludes.

Problems and Difficulties in Teaching Electoral Systems

Electoral system affects various aspects of politics; it is essential to understand how different electoral rules shape different political outcomes. However, it seems that college students do not understand the impacts of electoral systems well. This could be because our traditional teaching method has serious weaknesses and fails to communicate political-science findings with our students. This section clarifies two problems our traditional teaching method has after reviewing why electoral systems matter.

Why Does District Magnitude Matter?

As political institutions, electoral systems affect many aspects of politics and our lives. For instance, the electoral systems affect the party system. According to Duverger's law, the plurality rule with single member districts (SMDs) tends to favor the two-party system, and the proportional representation (PR) the multi-party system. In addition, the electoral systems change voting behavior. In the SMD system, voters may not vote for whom they prefer in order not to waste their votes. In contrast, under the PR system, they less likely worry about wasting their votes because their votes are proportionally transformed into seats. As these examples illustrate, political actors' behavior depends on the electoral systems. By understanding electoral systems, we can predict political actors' strategic behavior and hence form a meaningful expectation about political outcomes. Thus, students should learn the effects of electoral systems in order to understand politics better.

There are at least two effects that political-science students need to understand about electoral systems. One is the effect of district magnitudes; the other is that of the voting rules (Lijphart 2012). The former determines vote-to-seat proportionality and how many votes are wasted; the latter changes how voters express their preferences at the polls. In general, a single-member district (SMD) is paired with a single vote, and a multi-member district (MMD) with plural votes. However, there are quite a few combinations of the magnitude(s) and the voting rules; the large number of different electoral systems exist in the world. Therefore, it is difficult to observe a pure effect of the magnitude on electoral outcomes. What will we observe if only district magnitude changes, other things equal?

To observe the effects of district magnitude, Japan provides a good case because of its electoral reform in 1994. Before the reform, the Japanese lower house elections were competed under a rare electoral system, the multi-member district single-non-transferable vote (MMD-SNTV). Under this system, the voters wrote a candidate's name on a ballot, the winners are chosen by plurality rule, and the district magnitudes are typically between two and five depending on the population of the district.

The new electoral system after the reform is mainly SMD system.[3] The new system also employs the plurality rule and candidate ballots. However, it differs from the old system in the district magnitudes; the district magnitude is one in the new system. Because the voting rule was not changed by the reform, we could observe the relatively pure effects of district magnitude by comparing elections before and after the reform. This is why we focus on the MMD-SNTV system in Japan.

In fact, the electoral reform in 1994 changed Japanese politics. Before the reform, Japanese party system was categorized as one-party dominant system (Sartori 1976). The biggest party, the Liberal Democratic Party (LDP) had been in the government office from 1955 through 1993 without an interruption. Even the biggest opposition party, Social Democratic Party of Japan (JSP) had only about a half of the LDP's seats.[4] However, the reform lead to the collapse of the LDP-dominant system (Reed, Scheiner, and Thies 2012), and Japanese party system changed to the multi-party system. Given the change, the Democratic Party of Japan (DPJ) became the biggest opposition party, and finally the LDP government was replaced by the DPJ government in 2009. This illustrates how the electoral reform changed Japanese politics. Furthermore, it tells us that the electoral system matters a lot to political outcomes.

The old electoral system is also thought to have been a cause of sectionalism. There were some 120 electoral districts before the reform, and different numbers of seats were distributed to the districts depending on the population to elect more than 500 representatives in total. Accordingly, even if it had won a seat in all the districts, a party could not obtain the majority of the seats in the lower house – the House of Representatives – of the Diet.

To secure the majority of seats, parties were required to nominate more than one candidates in each electoral district, which resulted in competition within a party, especially among candidates who belonged to LDP (Tatebayashi 2004). Even though they shared broad policy goals because they belonged to the same party, LDP candidates were forced to compete with each other in a district. Consequently, many MPs specialized in specific policy areas[5] to differentiate themselves from other candidates, and they tried to benefit specific sections, groups, or regions that were related to their specialty. Some MPs represented the interests of farmers, and some others represented the interests of constructors. Because the policy making process within LDP was decentralized, various MPs could reflect their own interests on the government's policies.

As a consequence of the intra-party competition, voters tended to choose who they voted for based on their personal connection with candidates (Carey and Shugart 1995). Candidates distributed pork to specific groups of people to develop personal connections (Ramseyer and Rosenbluth 2009). In turn, voters cast their ballots to the candidate who had brought pork (Scheiner 2006). The old electoral system was a cause of pork-barrel politics.

The electoral reform has changed political elites' preferences. Under the new electoral system with 289 SMDs,[6] the number of votes required to win a district has increased. In addition, each party nominates only one candidate at most in a district. Thus, the intra-party electoral competitions disappeared. Distributing pork to specific groups of people is no longer enough to secure the seat of a district. Candidates represent the electorate more broadly than before, and policies become more programmatic (Horiuchi and Saito 2010; Rosenbluth and Thies 2010).

In sum, the electoral magnitude is politically consequential. Both candidates and voters changed their behavior and preferences by the electoral reform in Japan. It is complicated for students to instantly understand the mechanism, however. In the next subsection, we discuss difficulties in teaching the magnitude effects on candidates' behavior and some problems of traditional teaching methods.

Problems of Traditional Teaching Methods

In a typical undergraduate course in Japan, students study political science by attending lectures and reading required textbooks. As previous studies point out, this teaching method tends to make students reluctant to study further (Smith and Boyer 1996; Abe and Terazawa 1997; Omelicheva and Avdeyeva 2008; Wedig 2010), although it is efficient in terms of the number of students we can teach at the same time.

There are two main drawbacks in the traditional method. First, how well students understand a topic by lectures depends heavily on instructor's ability to talk because lectures are based on verbal communication. Probably all instructors should be a good story teller, but the truth is that only some are. Even among bright researchers, some are poor at talking. The whole political-science community should be better off if we develop some methods with which even a bad talker can get important concepts across students.

Second, it is hard for students to think about something that they have never experienced only by listening to lectures and reading books. At the moment, upper house elections and local elections are held under MMD-SNTV system. However, a number of students abstains from elections,[7] and hence they have probably not voted or run under an given electoral system yet. Thus, this electoral system is merely an unrealistic, theoretical possibility for them, and some students give up examining it carefully because they do not think that it matters to them.

To overcome these problems, we propose a new role-playing game.[8] In this game, an instructor sets the rules of the game, and the students play a role of an electoral candidate. The purpose of the game is to make students understand how district magnitudes change political outcomes, especially candidates' preferences and behavior. As previous studies show, active learning methods have a lot of advantages such as improving students' understanding, attendance, and relationship between students and instructors (Meyers and Jones 1993; McCarthy and Anderson 2000). This method does not depend on instructor's ability because students learn by themselves as players. We assert that giving a traditional lecture after the game can maximize students' understanding of the effects of district magnitude.

Role-playing Game

In this section, we present the detail of our role-playing game. First, we describe the design of the game: the setting and the procedure. Then, we show the results we expect and those we actually observe.

Design of the Game

The Rules

The rule of this role-playing game is simple. Some candidates run for election in a district where several groups of voters exist. Each player decides how much resource they distribute to each sector in their constituency. The number of votes each player gets is determined by the pre-specified distribution. We show a simple example below.

Suppose that the number of players is three and the constituency consists of four sectors. The sectors have 40,000, 30,000, 20,000, and 10,000 members, respectively, which means that the total population of the constituency is 100,000. The district magnitude is one, which implies that a candidate who gets the most votes will be the winner (plurality rule).[9] Every player has the fixed amount of resource, ten units. We write $d_1 = (2, 3, 1, 4)$ to describe the situation where Candidate 1 provides Sectors 1–4 respectively with two, three, one, and four units of the resource. Similarly, we write, for instance, $d_2 = (4, 3, 2, 1)$ and $d_3 = (3, 3, 2, 2)$ for the other candidates' resource allocations. Taking together, we express the distribution of the resource by a matrix:

$$D_1 = \begin{bmatrix} d_1 \\ d_2 \\ d_3 \end{bmatrix} = \begin{array}{c} \begin{bmatrix} 2 & 3 & 1 & 4 \\ 4 & 3 & 2 & 1 \\ 3 & 3 & 2 & 2 \end{bmatrix} \\ \begin{matrix} 1 & 2 & 3 & 4 \end{matrix} \end{array} \begin{array}{l} \text{Candidate 1} \\ \text{Candidate 2} \\ \text{Candidate 3} \\ \end{array} . \qquad \text{Sector} \tag{1}$$

The number of votes a player gets is determined by how much resource they distribute to a sector compared to the other candidates. For example, nine units of the resource are distributed to Sector 1 (the sum of the first column of D_1), and Candidate 1 provides two of nine units. Thus, the proportion of Candidate 1's contribution to Sector 1 is $\frac{2}{9}$. As a result, Candidate 1 gets two-ninths of Sector 1's 40,000 votes, which is 8,889 votes.

The candidates' relative contributions to the sectors can be written as

$$R = \begin{bmatrix} \frac{2}{9} & \frac{1}{3} & \frac{1}{5} & \frac{4}{7} \\ \frac{4}{9} & \frac{1}{3} & \frac{2}{5} & \frac{1}{7} \\ \frac{1}{3} & \frac{1}{3} & \frac{2}{5} & \frac{2}{7} \end{bmatrix}, \tag{2}$$

where a row represents a candidate and a column represents a sector. Since we examine how much candidates contribute to each sector, each column sums to unity.

Therefore, the number of votes that the candidates get is

$$V = R \begin{bmatrix} 40000 \\ 30000 \\ 20000 \\ 10000 \end{bmatrix} = \begin{bmatrix} 8889 + 10000 + 4000 + 5714 \\ 17778 + 10000 + 8000 + 1429 \\ 13333 + 10000 + 8000 + 2857 \end{bmatrix} = \begin{bmatrix} 28603 \\ 37207 \\ 34190 \end{bmatrix}, \tag{3}$$

and the winner is Candidate 2.

What we presented above are the basic rules. We, however, add another component *cost of competition* to the game in order to make it more realistic. The concept of the competition cost is drawn from the fact that it costs more to run for election if more players compete to attract the same sector. Let $c \in (0, 1)$ denote the base rate of the competition cost. The competition cost in each sector is a product of the base rate c and the number of candidates who compete in a sector. Assuming c is 0.1 and the distribution matrix

$$D_2 = \begin{bmatrix} 8 & 0 & 0 & 2 \\ 4 & 3 & 2 & 1 \\ 4 & 6 & 0 & 0 \end{bmatrix}, \tag{4}$$

the competition cost is 0.3 in Sector 1,[10] 0.2 in Sector 2,[11] and so on. Taking the competition cost into consideration, we define an adjusted distribution matrix as

$$D_{\text{adj}} = \begin{bmatrix} 7.7 & 0 & 0 & 1.8 \\ 3.7 & 2.8 & 1.9 & 0.8 \\ 3.7 & 5.8 & 0 & 0 \end{bmatrix}, \tag{5}$$

where we subtract the competition cost from the distribution matrix for positive elements so that all elements in the adjusted matrix are non-negative real numbers.[12]

Given these rules about how votes are distributed to the candidates, we now turn to describing the rule about the district magnitude. We set the magnitude either one (SMD) or three (MMD). The candidates in general are not allowed to negotiate or share information with each other, but there is an exception. In the game with MMD, Candidates 1 and 2 belong to the same party, so these players are allowed to negotiate and share information with each other.[13]

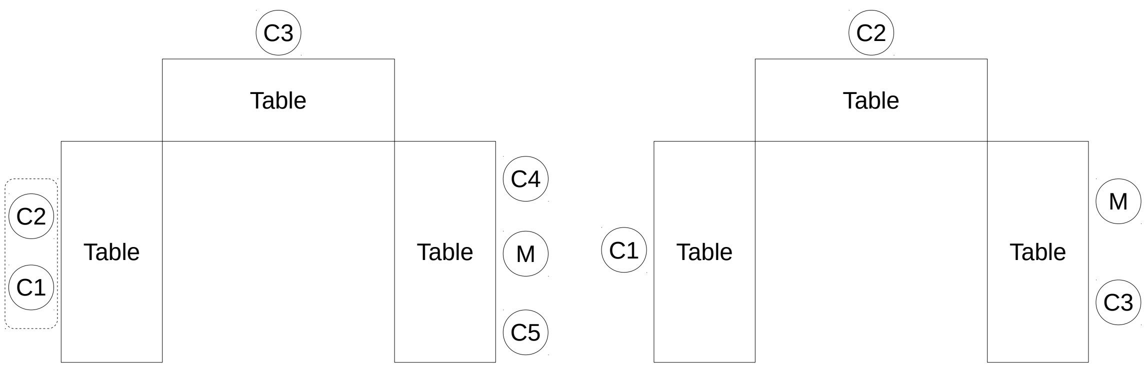
Game Setting

The setting of the game that we carried out is similar to that we described in the previous subsection. Table 1 summarizes the setting.

To familiarize students with learning through the game, we simulated the election ten times in each situation (SMD and MMD). We call each round of the game *task*. The students spent three minutes to implement a task.

Table 1: Setting of the game

	MMD-SNTV	SMD-Plurality
Number of players (each group)	5	3
District magnitude	3	1
Duration of each task	3 minutes	
Number of sectors	4	
Population of Sector 1	4,0000	
Population of Sector 2	30,000	
Population of Sector 3	20,000	
Population of Sector 4	10,000	
Each player's resource	10	



(a) MMD (b) SMD

Figure 1: Seating plans at a game table

Procedure

The procedure of the game is practically same for both SMD and MMD. The only difference is in their seating plans. Figure 1 shows the seating maps we used. C1 to C5 represent the candidates participating in the game,[14] and M represents the game master played by an instructor.

First, we invited 15 students from the *Political Culture* class,[15] randomly assigned them to groups – three in MMD-SNTV and five in SMD, and gave each a player ID. After players took their assigned seats, we explained the purpose and rules of the game. At this point, we demonstrated how to play the game with some examples.

Next, we handed out 20 distribution sheets.[16] The first ten sheets of them were for the

MMD-SNTV tasks. Accordingly, the first ten tasks were for the game with the MMD-SNTV rule. The remaining ten were for SMD.

Once the game master began the game, all players figured out what strategy they would take and filled out the answer sheet within three minutes. After three minutes elapsed, the game master collected the sheets from the players and calculated the number of votes each player obtained with R.[17] Then, the results were uploaded to a website.[18] The players opened the webpage and read all the results so far with their own smartphone or tablet computer.

This task was repeated ten times. After completing the games under MMD-SNTV situation, we shuffled the students and seated them in a way Panel (b) of Figure 1 depicts. We repeated a task for the game under SMD ten times as well.

Lastly, we provided each player with a gift card (500 yen or about 4.2 dollars) as prize for participation. At the guidance before the game, we announced that three best players would win a gift card and the best would be determined by the number of electoral victories in 20 games. However, since some players had advantage over the other due to the design of the game, we thought it unfair to keep the promise. Therefore, we gave all players a gift card.

Results

Expected Results

As mentioned above, the number of sectors in each electoral district is four. Table 2 shows the players' resource allocation to the four sectors. For example, Candidate 1 distributes eight out of ten units of the resource to Sector 1, zero to Sectors 2 and 3, and two to Sector 4 under MMD-SNTV. We expect Candidates 1 and 2 coordinate their resource allocations to maximize their chances to win a seat. As Table 2 suggests, Candidates 1 and 2 are expected to distribute their resources to different sectors in order not to compete with each other in securing votes. Due to the competition cost, it is better to concentrate their resources on the small number of sectors to maximize the number of votes gained by a unit of resource.

Table 2: Expected Result

Player	MMD-SNTV	SMD
Candidate 1	(8, 0, 0, 2)	(4, 3, 2, 1)
Candidate 2	(0, 6, 4, 0)	(4, 3, 2, 1)
Candidate 3	(4, 3, 2, 1)	(4, 3, 2, 1)
Candidate 4	(4, 3, 2, 1)	-
Candidate 5	(4, 3, 2, 1)	-

Although the resource allocation $(d_1 = (8, 0, 0, 2), d_2 = (0, 6, 4, 0))$ does not guarantee the victories of either Candidate 1 or Candidate 2, this allocation gives them a good chance of winning. With $(d_1 = (8, 0, 0, 2), d_2 = (0, 6, 4, 0))$, if the other candidates select their allocation randomly, the probabilities of winning a seat for Candidates 1 and 2 are about 0.97.[19] In contrast, the other players' winning probabilities are 0.35, 0.35, and 0.36, respectively.[20] The expected results for d_1 and d_2 are clear, but how about d_3, d_4, or d_5? In short, $d_{i\geq 3}$ should be $(4, 3, 2, 1)$. If Candidates 1 and 2 adopt the expected strategies, they rarely lose. As a result, the number of seats left for the other three candidates is only one, which is equivalent to the SMD situation competed by three candidates.

Unlike MMD-SNTV, no player has incentive to change their resource allocation under SMD once the allocations converge to those shown in Table 2.[21] However, it does not mean that an allocation assuring a candidate a seat always exists. Whether a candidate wins or loses with a specific allocation depends on the other candidates' behavior. Our numerical analysis suggests that the winning probability of $d_1 = (4, 3, 2, 1)$ in SMD is about 0.9 if the other players randomly choose their allocations.[22]

Based on these considerations, we expect that the resource allocation should be $d_1 = (8, 0, 0, 2)$, $d_2 = (0, 6, 4, 0)$, $d_3 = (4, 3, 2, 1)$, $d_4 = (4, 3, 2, 1)$, and $d_5 = (4, 3, 2, 1)$ under MMD-SNTV and $d_i = (4, 3, 2, 1)$ for any i under SMD for three reasons. First, these allocations give the candidates the highest probability of winning a seat. The winning probability of the expected allocation is about 2.8 times higher than other allocations in MMD-SNTV and 18 times higher in SMD. Second, Candidates 3, 4, and 5 are disadvantaged in terms of information about the others' behavior compared to Candidates 1 and 2 in MMD-SNTV. To beat Candidates 1 and 2, the other candidates need to divide the sectors and distribute the resource intensively to a specific sector. However, they cannot share information due to the rule of the game. Unless they share information, it is extremely difficult for Candidates 3, 4, and 5 to beat Candidates 1 and 2. Lastly, to win without dividing the sectors, Candidates 3, 4 and 5 need to choose a relatively unrealistic resource allocation that distributes the larger amount of resource to the less populated sector(s). It is difficult to choose this kind of allocations because Candidates 3, 4 and 5 cannot predict how much resource the other candidates distribute to each sector. As a result, the rational candidates who maximize the probability of winning a seat should select the resource allocation we found.

Observed Results

Figures 2 to 4 present the results of the game. We will explain the results of MMD-SNTV and those in SMD in turn. Explanation of the MMD-SNTV results is divided into two parts. One is for Candidates 1 and 2, who belong to the same political party, and the other is for Candidates 3, 4, and 5, who are members of three different parties.

Since it is difficult to show the results for Candidate 1 and 2 in MMD due to the fact that the best resource allocations for them are interchangeable, we show the results using the effective number of candidates (ENC), which is an application of the effective number of political parties (Laakso and Taagepera 1979). If two players in the same party divide the sectors and concentrate their resource on the chosen sectors, ENC is one. For the purpose of illustration, suppose that Candidate 1 provides Sector 1 with five units of the resource and Candidate 2 gives Sector 1 with five units as well. In this case, ENC is 2 for Sector 1.[23] If Candidate 1 transfers three units and Candidate 2 distributes seven units, ENC is 1.72.[24] When only one candidate provides a sector with the resource, ENC is 1.[25] Therefore, if the two candidates in the same party divide sectors, ENC will be close to 1.

Figure 2 visualizes the mean ENC of all groups by task. In this figure, the horizontal axis presents tasks (elections), and the vertical axis the ENC. The four lines show the sectors'

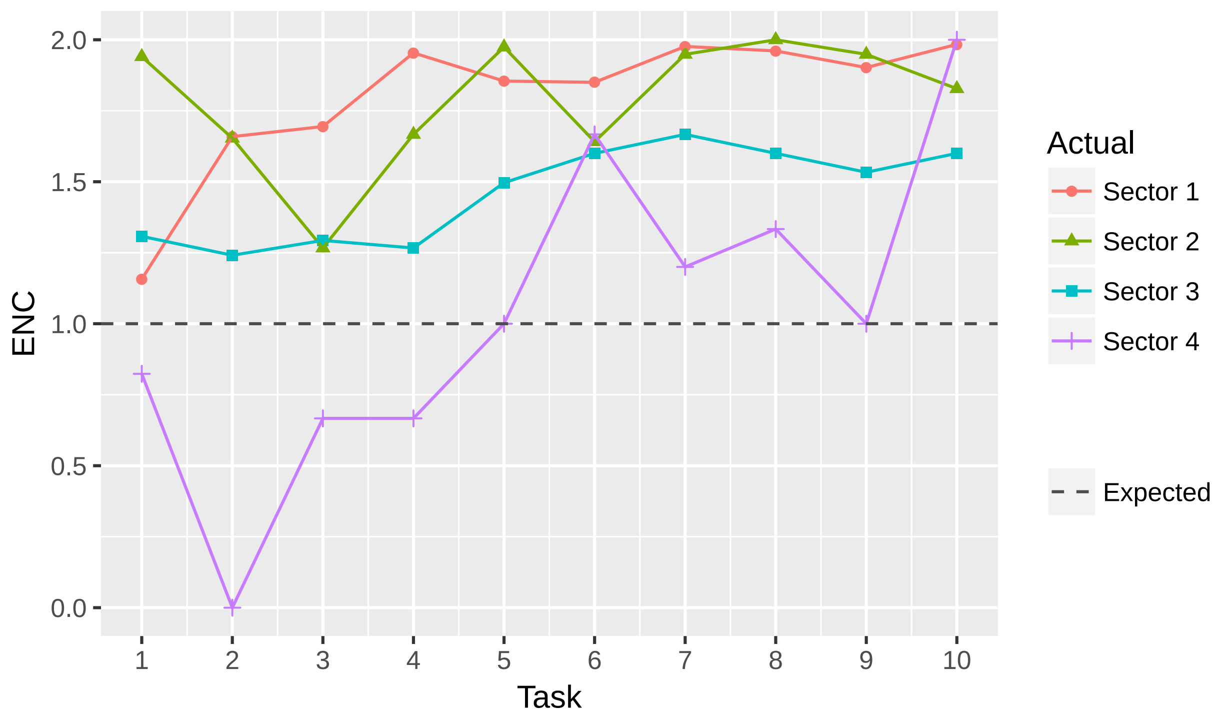


Figure 2: Result of the Game: MMD - Candidates 1 and 2

ENC in each task, and the horizontal dashed line clarifies where $ENC = 1$. The results shown in Figure 2 contradict with our expectation that the ENC converges to 1. The observed mean of the ENC is between 1.5 to 2.0. In sum, the results of the MMD-SNTV game deviated from our expectation.

Although the ENC becomes smaller as the population of the sector decreases, it is probably not because the candidates tried to avoid a conflict but because a smaller sector was less attractive as an investment destination.

Next, let us explain the results for Candidates 3, 4, and 5. Figure 3 presents the mean of distributed resources to four sectors in each election. Four lines in the figure are the amounts of the resource the sectors received. It is shown that these candidates adopted to the expected resource allocation, $d = (4, 3, 2, 1)$. In the last three tasks, Candidates 3, 4, and 5 adapt to the allocations similar to our expectation.

Overall, our expectation was partially supported. Candidates 1 and 2 did not act as we expected while the other candidates selected the best allocations we had found. We discuss

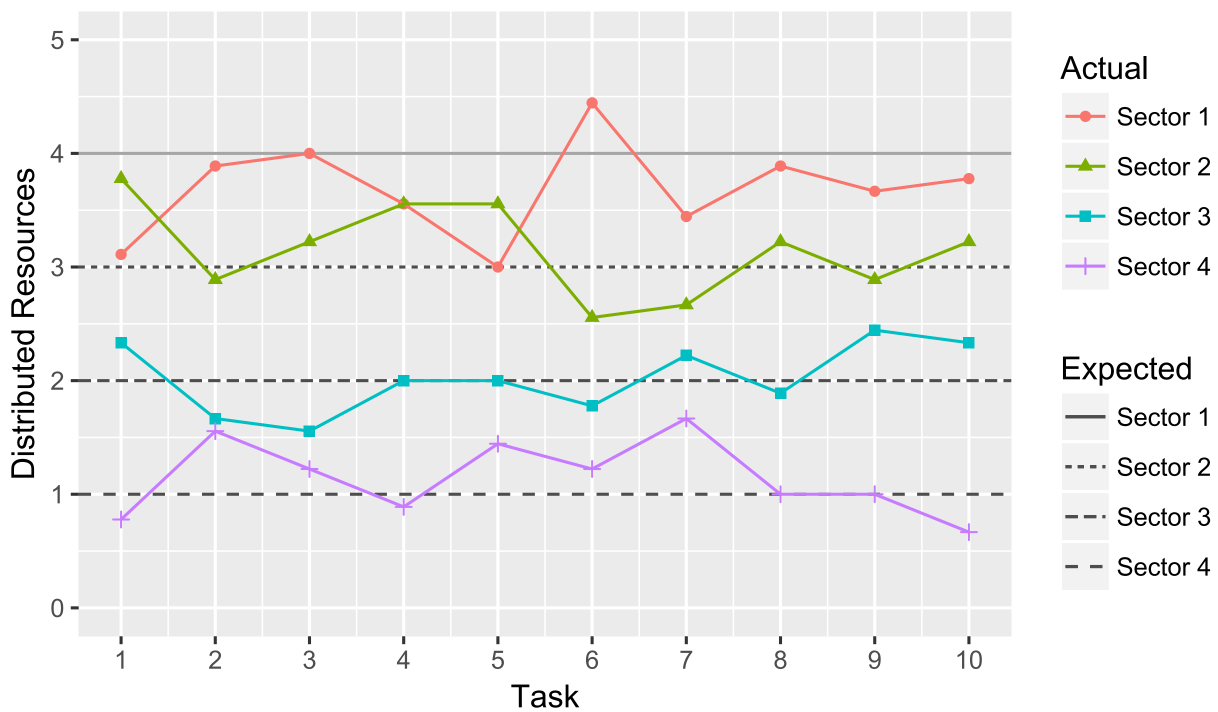


Figure 3: Result of the Game: MMD - Candidates 3–5

the discrepancy between our expectation and the results in the next subsection.

Figure 4 shows the results of the SMD game. Similar to Figure 3, the means of distributed resources to four sectors in each task are presented. As we expected, many students chose the allocation $d = (4, 3, 2, 1)$.

In the game of MMD-SNTV played by the students, $d_i = (4, 3, 2, 1)$ did not maximize their chance to win because Candidates 1 and 2 deviated from our expectation.[26]. Although it could be a good distribution in some tasks, whether it is the best in a given task depends heavily on the other players' behavior.

Why Did We Not Get the Expected Results?

Why did the students assigned to Candidates 1 and 2 not choose to divide the sectors in the MMD-SNTV game? During the game, we heard students playing Candidates 1 and 2 talking. Based on what we heard, they noticed that they would be better off if they could cooperate, but they did not manage to find a way to benefit both. Since they simulated only

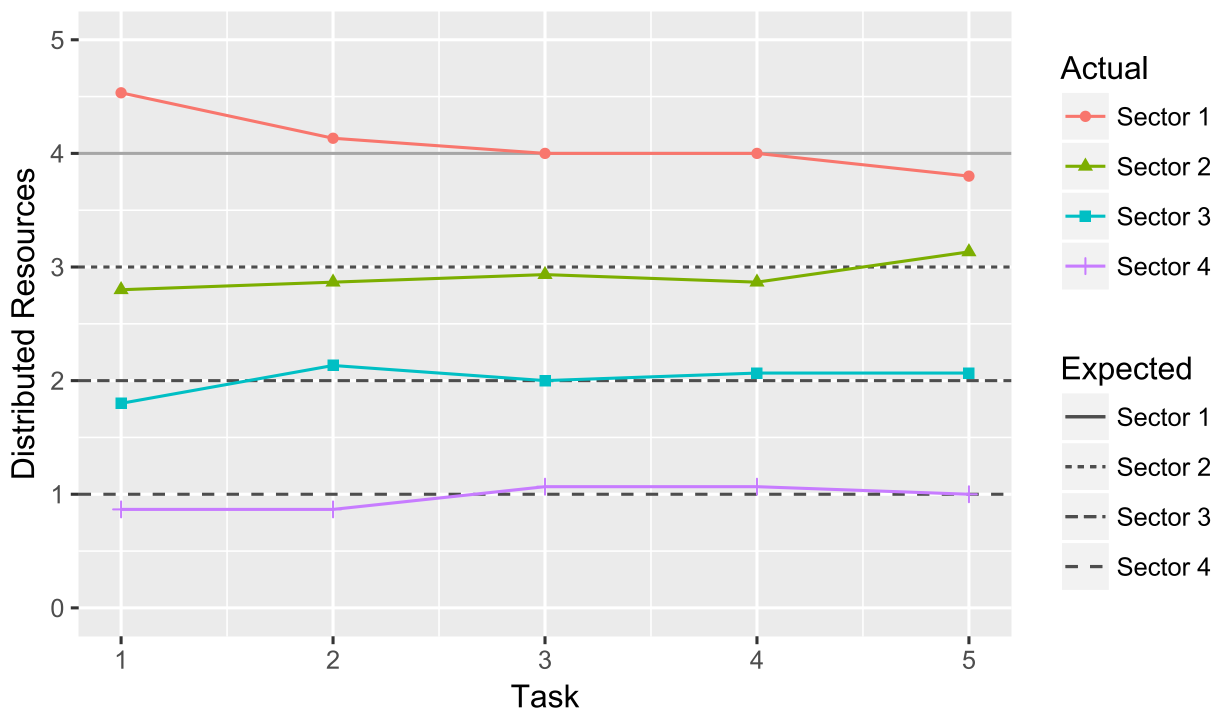


Figure 4: Result of the Game (SMD)

ten elections, they might think that it could be risky to provide big sectors with none of the resource. Before starting the game, we told the students that only three winners would get the bonus to stimulate their motivation. The maximum number of election they could win was ten in a game, and they might think losing one out of ten had a non-negligible effect on the final ranking. Therefore, they might have minimized the risk of losing a task rather than maximizing the chance of winning. As the figures above suggest, the students were willing to sacrifice Sector 3 or 4, which is a relatively small sector, but they were not ready for discarding Sector 1 or 2, which is relatively large.

Evaluation of the Game

In this section, we evaluate our game in teaching the effects of electoral systems. We focus on two questions: (1) Did students enjoy the game? and (2) Did the role-playing game help students understand the effects of district magnitude? After introducing evaluation criteria, we show our self-evaluation of the game.

Evaluation Methods

We rely on two methods to evaluate how effective our game is. First, to evaluate how much students enjoyed playing the game, we conducted a simple survey with the following questions.[27] The participants anonymously answered these questions.

Q1 How actively do you think you participated in the game compared to usual classes?

1. I participated much more actively in the game than in usual classes.
2. I participated more actively in the game than in usual classes.
3. I participated in the game as actively as in usual classes.
4. I participated less actively in the game than in usual classes.

Q2 How much did you enjoy playing the game?

1. I enjoyed the game very much.
2. I fairly enjoyed the game.
3. I did not enjoy the game much.
4. I did not enjoy the game at all.

Q3 How much do you think the game you played helped you understand why electoral systems matter?

1. It helped me a lot.
2. It helped me to some degree.
3. It did not help me much.
4. It did not help me at all.

The second evaluation uses an experimental method. Two days after the game was conducted, the instructor of the Political Culture class gave a lecture about consequences of different electoral systems including MMD-SNTV and SMD. During the class, he talked about how district magnitudes affect candidates' preferences. After the lecture, we conducted a simple survey in the class. The survey asked the students how much they thought they had understood the content of the lecture. That is, we tried to measure the subjective degree of understanding among the students. The question reads:

Q4 How much do you think you understood the following points?

- Connection between the district magnitude and candidates' preferences.
- Relation between the electoral system and factionalism of political parties.
- $M + 1$ rule.

1. I understood it very well.
2. I somewhat understood it.
3. I did not understand much.
4. I did not understand at all.

We call the students who attended our game *and* class *treatment group* and those who attended only the class *control*. If the subjective degree of understanding is higher in the treatment group than in the control group, we could believe that our method worked.

Ideally, we should compare a group that participated only in the game with another group taking only the class. However, we could not make such a control group because the students in the treatment group were taking the class. Therefore, we test the effectiveness of our method by comparing the treatment and control groups we defined.

The average treatment effect of the game can be calculated as follows.

$$U_{\text{class}} = E_{\text{verbal}}. \tag{6}$$

$$U_{\text{game}} = E_{\text{verbal}} + E_{\text{game}} + \beta(E_{\text{verbal}} \cdot E_{\text{game}}). \tag{7}$$

U_{class} represents the degree of understanding about electoral systems among the students who did not participate in the game. U_{game} is that of those who participated in both the class and the game. Lastly, E is an effect of each method and β is a coefficient of the interaction term, a synergy effect. We assume that β is a non-negative real number.[28] We cannot measure a pure effect of the game by simply subtracting Equation 6 from Equation 7.[29] However, if E_{game} and E_{verbal} are non-negative, U_{game} must be more than U_{verbal}.[30] If our game did not affect the learning outcome ($E_{\text{game}} = 0$), U_{game} should equal U_{verbal}. This implies that the role-playing game improves students' learning if $U_{\text{game}} \geq U_{\text{verbal}}$.

Since we asked the students to show their student IDs and their names to differentiate the treatment group from the control group, they might have thought that their answers to the survey would affect their grade. To avoid this misunderstanding, we informed the students that the answers would never contribute to their grades, positively or negatively.

Results

Table 3 presents the evaluations from the post-game survey. Our role-playing game was positively evaluated from the participants. As shown in the table, the students participate more actively in the game, enjoyed it more, and think it more helpful than a normal lecture. At the very least, the game is less likely to damage students' learning motivation.

To evaluate whether the students understood the effect, we created a dichotomous variable from the four-category evaluation. We regard the students who "understood very well" and "somewhat understood" as "positive response", and those who "did not understand much" and "did not understand at all" as "negative response." Table 4 tells us how effec-

Table 3: Summary of post-game evaluation

	Participation	Enjoying	Helpful
Mean	3.60	3.60	3.21
SD	0.51	0.51	0.80

Note: N = 15
Larger value means more positive response.

Table 4: Summary of post-lecture evaluation (Degree of understanding)

Group	N	M + 1 Rule	Magnitude	Faction
Pooled	75	0.800 (0.403)	0.747 (0.438)	0.693 (0.464)
Control	63	0.810 (0.396)	0.714 (0.455)	0.698 (0.463)
Treatment	12	0.750 (0.452)	0.917 (0.289)	0.667 (0.492)

Note: Larger value represents better understanding.
The figures in parentheses are standard deviations.

tive the game was. As mentioned above, we asked three questions that measure students' subjective degree of understanding of three points: M + 1 rule, a consequence of district magnitude, and a relation between electoral system and factionalism. Since sophomores, juniors, and seniors were in the class[31] and they might have different background knowledge.

Then, we compare the students in the control group with those in the treatment group. We call the students who participated in the game *treatment* group and the others *control*. If our method was effective, the proportion of "understood" should be higher in the treatment than in the control. Furthermore, the other points – M+1 rule and the relationship between the electoral system and factionalism – must have the similar proportion of "understood" for both the treatment and control groups.

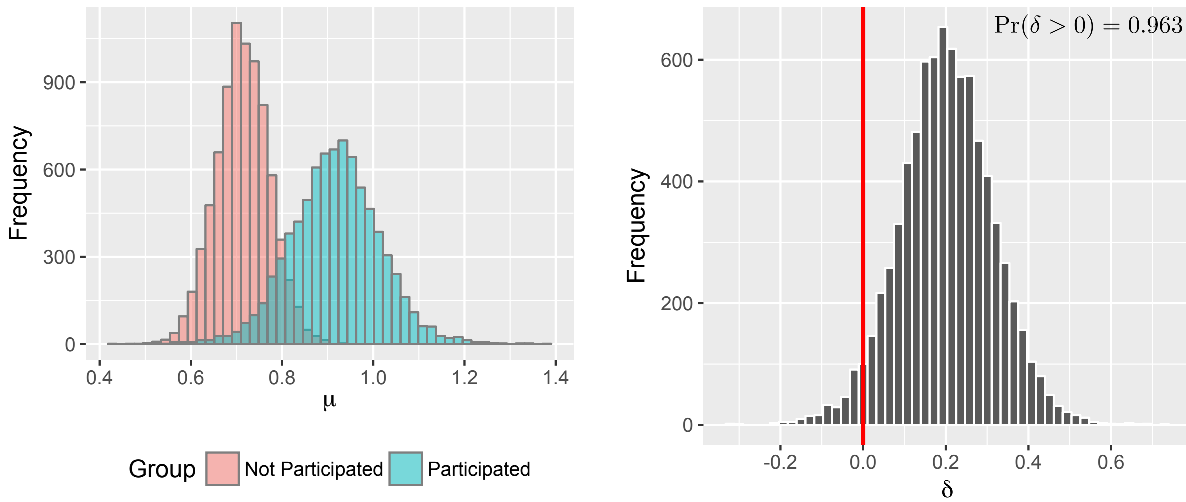
To check whether our game improved participants' understanding of the effects of district magnitude, we conducted t-test. We assume that the degrees of understanding about the effect of district magnitude are generated as follows:[32]

$$
\begin{aligned}
U_{\text{Treatment}} &\sim \text{Normal}(\mu_1, \sigma_1), \\
U_{\text{Control}} &\sim \text{Normal}(\mu_2, \sigma_2), \\
\delta &= \mu_1 - \mu_2, \\
\mu_{g\in\{1,2\}} &\sim \text{Normal}(0, 10^4), \\
\sigma_{g\in\{1,2\}} &\sim \text{Normal}^{+}(0, 10^4). \qquad (8)
\end{aligned}
$$

U is the degree of understanding about the effects of district magnitude, and it follows normal distribution with means of μ_g and standard deviation of σ_g. Students in the treatment and control groups have different parameters of the normal distribution. μ_1 and σ_1 are parameters for the treatment group. μ_2 and σ_2 are those of control group. δ is a difference between μ_1 and μ_2. If δ is over 0, our game is considered effective.[33]

Figure 5 shows the posterior distribution of μ and δ.[34] Posterior distribution shows estimated distribution of a parameter given data. A converge index, $\hat{R}$, of all the parameters are less than 1.1, thus we regarded the posterior distributions converged. As Panel (a) of the figure shows, the means of μ_1 and μ_2 are 0.92 and 0.72, respectively, which means that subjective degree of understanding in the treatment group is higher than that in the control group by 0.2. To check how much the game was effective, we presents the posterior distribution of δ in Panel (b). The most proportion of the posterior distribution of δ is located on the right side of 0, and the probability that δ is greater than 0 is approximately 0.96. Thus, we insist that our game was effective with probability of 0.96.

In short, compared with the students who only listen to the lecture, our game players achieved better understanding of the effects of electoral systems.



(a) Posterior Distribution of μ

(b) Posterior Distribution of δ

Figure 5: Posterior distribution of the estimated parameters

Conclusion

In this paper, we have proposed a new method for teaching the effects of electoral systems, especially those of the district magnitude. We have shown that many students actively participated in our role-playing game; they enjoyed playing it and felt it useful. Furthermore, our game improved students' understanding about the effect of district magnitude with high probability.

The game introduced in this paper focuses on the district magnitude. Especially when we teach an electoral systems that no student in class has experienced before, such as MMD-SNTV, the role-playing game is useful. To maximize the effect of the game, it is essential to deliberately design game settings and procedure. For example, we suggest that an instructor upload the results of each game on a webpage as we did so that students can check how well they are playing by themselves.

Lastly, we would like to address limitations of our game and suggest how we overcome it. In the game under the MMD-SNTV rule, no player who was assigned to the same party with another adopted the best allocation of the resource. Although it is not difficult to alleviate this problem in theory, there exists some difficulties in practice. First, students need learning periods. We could get the better results by increasing the number of tasks in a game from 10 to 20 or more. Increasing the number of iterations is effective in learning, but it takes longer to play a game. Because it took an hour to play a game with ten tasks, it might be impractical to increase the number of tasks for a class.[35]

Second, studentss might be shy. We could obtain better results if we made Candidates 1 and 2 to communicate easily with each other. Because we randomly assigned participants to political parties, Candidates 1 and 2 did not know each other in some pairs. In such a case, the two candidates might have hesitated to talk with each other. Communication is essential to reach the optimal distribution. Thus, we should assign a pair of acquaintances to Candidates 1 and 2.

Notes

[1]The voting age in Japan was lowered from 20 to 18 before the 2016 House of Councillors Election, so all college students are now eligible to vote because most universities accept students who are 18 or older.

[2]Many of them must have experienced some elections such as an election for the student council at high school, but they seem to think that these elections are "fake." It is probably because these elections are small in scale.

[3]In fact, the new system is mixed member majoritarian system, which mixes the SMD and PR tiers.

[4]Hence, it was also called the one-and-a-half party system.

[5]MPs with specialized areas are called *Zokugiin* in Japanese, where *zoku* means "tribe" and *giin* means "MP."

[6]The number of SMDs was 300 at the time of installation, decreased to 295 in 2014, and reduced to 289 in 2017.

[7]The voter turnout of twenties is about 30% in upper house elections in recent years.

[8]The simulation is applied to many political process such as congressional committee (Mariani and Glenn 2014), mock election and coalition-formation (Shellman 2001), and global problems summit (Krain and Lantis 2006).

[9]If two or more candidates are tied, the winner is randomly chosen.

[10]The number of candidates who contribute to Sector 1 is three, so the cost is $0.1 \cdot 3 = 0.3$

[11]The number of candidates who contribute to Sector 2 is two, so the cost is $0.1 \cdot 2 = 0.2$.

[12]That is, we do not subtract cost if the allocation is zero in the distribution matrix.

[13]It is not allowed to transfer the resource between candidates.

[14]C1 and C2 in Panel (a) of Figure 1 belong to the same party.

[15]We sent out 64 invitation letters, 50 of the invitees applied for participation. Then, we sampled 15 students randomly from 50.

[16]A detail of the distribution sheets and result sheets is available at the author's website.

[17]R code is available at the author's website.

[18] The author's website.

[19]The probability of both candidates losing is 0.005%.

[20]The number of allocation combinations are 23,393,656, so it is time-consuming and practically impossible to calculate the probabilities for all or find out the best allocation. We sampled only 100,000 combinations and calculated them numerically.

[21]A numerical proof is in an appendix available at the author's website.

[22]The number of possible combinations for Candidates 2 and 3 is $81,796$, and Candidate 1 wins $73,639$ times with the allocation $d_1 = (4, 3, 2, 1)$. The probabilities of Candidates 2 and 3's winning are about 0.05. We calculated these probabilities in the same way as we did for MMD-SNTV, but we did not sample the strategies.

[23]$\frac{1}{0.5^2+0.5^2} = 2.$

[24]$\frac{1}{0.3^2+0.7^2} = 1.72.$

[25]$\frac{1}{1.0^2+0^2} = 1.$

[26]If Candidates 1 and 2 had selected the expected distribution, $d = (4, 3, 2, 1)$ could have been the best for the others

[27]All questions were asked in Japanese.

[28]If β is negative, U_{game} can have a negative value. We can keep the value positive by restricting β in a specific range: $\beta \geq -\frac{E_{\text{verbal}}+E_{\text{game}}}{E_{\text{verbal}} \cdot E_{\text{game}}}$. Although it is extremely difficult to interpret the meaning of this range, assuming a postive β does not undermine our argument below.

[29]This means that we cannot estimate the interaction effect between the verbal method and the role-playing method. If we had assigned some students to a group that participate in the role-playing game but not in the class, we could have estimated the interaction effect. However, in order to provide an equal opportunity of learning with each student, we could not create such a group.

[30]We assume β is a non-negative real number, but if β is restricted as $\beta \geq -\frac{E_{\text{verbal}}+E_{\text{game}}}{E_{\text{verbal}} \cdot E_{\text{game}}}$, this statement is still sustained unless β is exactly $-\frac{E_{\text{verbal}}+E_{\text{game}}}{E_{\text{verbal}} \cdot E_{\text{game}}}$. In this case, U_{game} is always

zero regardless of E_{game}. However, β defined in this way can cause a serious problem. If E_{game} equals zero, the denominator of $\frac{E_{\text{verbal}}+E_{\text{game}}}{E_{\text{verbal}} \cdot E_{\text{game}}}$ will be zero, so the range of β is not defined. That is, restricting β is not a problem save a few specific situations, but it is more desirable to assume a non-negative real β.

[31]The class had some over-seniors and graduate students. We excluded them from our analysis. Furthermore, the students who participated in the pilot game were also excluded.

[32]Parameters of each normal distribution are mean and standard deviation.

[33]We used R 3.4.1 (R Core Team 2015) and rstan 2.16.2 (Stan Development Team 2016) to estimate the parameters.

[34]The posterior distributions of σ are shown in an appendix available at the author's website.

[35]It takes about three minutes to complete a task. We can make it shorter if we automatize some procedures using laboratory experiment tools such as z-Tree or oTree.

References

Abe, Kazuhiro, and Koichi Terazawa

1997 "A Turning Knowledge Communication-centered Lecture to Learning-centered Lecture in University Education: Student-centered Group Learning Model in a Large Size Class [Digakukyōiku niokeru chishikidentatsuchuūshinjyugyō kara gakushūchūshinjyugyō heno tenkan: Taninzūkurasu niokeru gakuseichūshin shōgrūpugakushū model.]." *Journal of Higher Education* Special Edition: 128–137.

Carey, John M, and Matthew Soberg Shugart

1995 "Incentives to Cultivate a Personal Vote: A Rank Ordering of Electoral Formulas." *Electoral studies* 14(4): 417–439.

Horiuchi, Yusaku, and Jun Saito

2010 "Cultivating Rice and Votes: The Institutional Origins of Agricultural Protectionism in Japan." *Journal of East Asian Studies* 10(3): 425–452.

Krain, Matthew, and Jeffrey S. Lantis

2006 "Building Knowledge? Evaluating the Effectiveness of the Global Problems Summit Simulation." *International Studies Perspectives* 7(4): 395–407.

Laakso, Markku, and Rein Taagepera

1979 "Effective Number of Parties: A Measure with Application to West Europe." *Comparative Political Studies* 12(1): 3–27.

Lijphart, Arend

2012 *Patterns of Democracy: Government Forms and Performance in Thirty-six Countries*. Second ed. New Haven, CT: Yale University Press.

Mariani, Mack, and Brian J. Glenn

2014 "Simulations Build Efficacy: Empirical Results from a Four-Week Congressional Simulation." *Journal of Political Science Education* 10(3): 284–301.

McCarthy, Patrick J., and Liam Anderson

2000 "Active Learning Techniques Versus Traditional Teaching Styles: Two Experiments from History and Political Science." *Innovative Higher Education* 24(4): 279–294.

Meyers, Chet, and Thomas B. Jones

1993 *Promoting Active Learning: Strategies for the College Classroom.* San Francisco, CA: Jossey-Bass Publishers.

Omelicheva, Mariya Y., and Olga Avdeyeva

2008 "Teaching with Lecture or Debate? Testing the Effectiveness of Traditional versus Active Learning Methods of Instruction." *PS: Political Science and Politics* 41(3): 603–607.

R Core Team

2015 *R: A Language and Environment for Statistical Computing.* Vienna, Austria: R Foundation for Statistical Computing.

Ramseyer, Mark J., and Frances McCall Rosenbluth

2009 *Japan's Political Marketplace.* Cambridge, MA: Harvard University Press.

Reed, Steven R., Ethan Scheiner, and Michael F. Thies

2012 "The End of LDP Dominance and the Rise of Party-oriented Politics in Japan." *The Journal of Japanese Studies* 38(2): 353–376.

Rosenbluth, Frances McCall, and Michael F. Thies

2010 *Japan Transformed: Political Change and Economic Restructuring*. Princeton, NJ: Princeton University Press.

Sartori, Giovanni

1976 *Parties and Party Systems: A Framework for Analysis*. Cambridge: Cambridge University Press.

Scheiner, Ethan

2006 *Democracy Without Competition in Japan: Opposition Failure in a One-Party Dominant States*. New York, NY: Cambridge University Press.

Shellman, Stephen M

2001 "Active Learning in Comparative Politics: A Mock German Election and Coalition-Formation Simulation." *PS: Political Science & Politics* 34(4): 827–834.

Smith, Elizabeth T., and Mark A. Boyer

1996 "Designing In-Class Simulations." *PS: Political Science and Politics* 29(4): 690–694.

Stan Development Team

2016 "RStan: the R interface to Stan."

Tatebayashi, Masahiko

2004 *Giinkōdō no seijikeizaigaku: Jimintōshihai no seidobunseki* [*A Political Economics of Diet Members: A System Analysis of Rule*]. Tokyo: Yuhikaku.

Wedig, Timothy

2010 "Getting the Most from Classroom Simulations: Strategies for Maximizing Learning Outcomes." *PS: Political Science and Politics* 43(3): 547–555.