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

In this article we propose a new role-playing game to teach the effects of electoral systems on politicians' preferences 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 a consequential impact on politics. However, we often fail to effectively teach the importance of the electoral system because of weaknesses in the traditional, didactic teaching methods. To improve political science education, we have developed a game in which students can learn how electoral systems affect politicians' behavior by playing the role of an electoral candidate. Our experiment shows that the game could be effective supporting material for lectures on the impact of electoral systems. Our game serves as an addition to the repertoire of active-learning in political science.

keywords: teaching methods, active learning, role-playing simulation game, district magnitude, electoral systems

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Elections are essential for a modern representative democracy, and in advanced industrial societies a democracy cannot be sustained without them. Even with them, a democracy could malfunction if elections are corrupt or arbitrarily manipulated. Citizens living in democracies are expected to monitor democratic elections and, 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 easy for students to learn about 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, other systems discourage possible candidates and thus reduce the number of runners. Multiple candidates win a seat in a district under some rules, but only one gets a seat under other rules. Some systems allow the voters to write a candidate's name on the ballot, but others require voters to choose a political party from a list. Voters can cast a single ballot in a district under some electoral systems, while they have the chance to vote for more than one candidate or party in a district under other systems. In short, electoral systems change the behavior of both candidates and voters in elections. It is painstaking for students to understand which electoral systems lead to which outcomes.

Teachers can list and discuss the characteristics of several electoral systems in class, but this is boring for students because a large number of them think that most of the systems are irrelevant for them. Most students do not seem to have the chance to experience or even observe foreign elections. Even worse, many students are not even interested in the electoral system in their own country, and to a certain degree this is because they have never voted. In Japan, which we use as our example in this article, the voting age was twenty until the lower house election in 2014.[1] Since most

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1. The voting age in Japan was lowered from twenty to eighteen before the 2016 House of Councilors election, so all college students are now eligible to vote because most universities accept students who are eighteen or older.

students enter college at the age of eighteen or nineteen, the vast majority of a class does not have a direct experience of elections when we teach them about electoral systems.[2] Therefore, we decided to devise an easy and fun way to teach about electoral systems to make students understand them better.

In this article, 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 a candidate's political behavior. Students play the role of an electoral candidate and aim for an electoral victory. By experiencing the thought process of electoral candidates, the students learn how the rules of the game shape the incentives of political actors. By simulating two different sets of electoral rules, we help the students to 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 article proceeds as follows. In the next section, we explain why it is both important and difficult to teach about electoral systems to college students using traditional methods of teaching. Then, in the third section, we propose a new gaming method that we call simply "Role-Playing Game." After introducing the game design, we put forward our expected results for the game. We then present the results of the game played by students and discuss the differences between the expected and observed results. The fourth section evaluates the effects of our game. We show that our method improves students' understanding of electoral systems, though the effect seems to be small. Finally, we summarize our findings in the conclusion.

Problems and Difficulties in Teaching about Electoral Systems

Electoral systems affect various aspects of politics, and it is essential to understand how different electoral rules shape different political outcomes. However, it seems that college students do not really understand the impact of electoral systems well. This could be because our traditional teaching methods have serious weaknesses and fail to communicate the findings of political science with our students. This section clarifies two problems of traditional teaching methods after reviewing why electoral systems matter.

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." This is probably because these elections are small in scale.

WHY DOES DISTRICT MAGNITUDE MATTER?

As political institutions, electoral systems affect many aspects of politics and our lives. For instance, 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 proportional representation (PR) the multi-party system. In addition, 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 are less likely to worry about wasting their votes because their votes are proportionally transformed into seats. As these examples illustrate, the behavior of political actors depends on the electoral systems. By understanding electoral systems, we can predict the strategic behavior of political actors 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, an 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 voting rules; a 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, all other things remaining equal?

Japan provides a good example in which to observe the effects of district magnitude 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 were chosen by the plurality rule, and the district magnitudes were typically between two and five depending on the population of the district.

The new electoral system following reform is mainly a SMD system.[3] The new system also employs the plurality rule and candidate ballots.

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

However, it differs from the old system in the district magnitudes; the district magnitude is in the new system. Because the voting rules were not changed during the reform, we were able to observe the relatively pure effect 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 of 1994 changed Japanese politics. Before the reform, the Japanese party system was categorized as a one-party-dominant system (Sartori 1976). The biggest party, the Liberal Democratic Party (LDP), had been in power from 1955 through 1993 without interruption. Even the biggest opposition party, the Social Democratic Party of Japan (SDP), had only about half of the LDP's seats.[4] However, the reform led to the collapse of the LDP-dominant system (Reed, Scheiner, and Thies 2012), and the Japanese party system changed to a 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 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 a majority of the seats in the lower house—the House of Representatives—of the Diet.

To secure a majority of seats, parties were required to nominate more than one candidate in each electoral district, which resulted in competition within parties, especially among candidates who belonged to the LDP (Tatebayashi 2004). Although 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 others represented those of constructors. Because the policy making process

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."

within the LDP was decentralized, various MPs could reflect their own interests in 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.

Electoral reform has changed the preferences of political elites. 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).[7]

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

PROBLEMS OF TRADITIONAL TEACHING METHODS

In a typical undergraduate course in Japan, students study political science by attending lectures and reading the required textbooks. As previous studies have pointed 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.

6. The number of SMDs was 300 when the first election under this system was held in 1996.

7. Following the change from MMD-SNTV to SMD, vote choice depends more heavily on political parties than on candidates. As a result, many candidates do not strategically cultivate personal votes to get elected. Ideally, we could incorporate the importance of political parties under different electoral systems. However, it may be difficult for students to understand how the electoral system affects both resource allocation and personal vote seeking at the same time. Therefore, we restrict the focus of our game to resource allocation by candidates.

There are two main drawbacks to the traditional method. First, how well students understand a topic via lectures depends heavily on an instructor's ability because lectures are based on verbal communication. All instructors should ideally be good storytellers, but the truth is that only some are. Even among brilliant researchers, some have poor communication skills. The whole political-science community would be better off if methods exist in which even inexperienced teachers can get important concepts across to 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 the MMD-SNTV system. However, a number of students abstain from elections,[8] and hence they have probably not voted or run under a 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 have developed a new role-playing game.[9] In this game, an instructor sets the rules of the game, and the students play the 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 have shown, active learning methods have a lot of advantages, such as improving students' understanding, attendance, and the relationship between students and instructors (Meyers and Jones 1993; McCarthy and Anderson 2000). This method does not depend on an 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 details of our role-playing game. First, we describe the design of the game: the setting and the procedure. Then, we show the results we expected and those we actually observed.

8. The voter turnout for those in their twenties is about 30 percent in the upper house elections in recent years.

9. The simulation is applied to many political processes such as a congressional committee (Mariani and Glenn 2014), mock elections and coalition formation (Shellman 2001), and a global problems summit (Krain and Lantis 2006).

DESIGN OF THE GAME: THE RULES

The rules of this role-playing game are simple. Some candidates run for election in a district where several groups of voters exist. Each player decides what resources they will distribute to each sector in their constituency. The number of votes each player gets is determined by the pre-specified distribution.[10] We give 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).[11] Every player has a fixed amount of resources (ten units).[12] 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. Taken together, we express the distribution of the resource by a matrix:

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

The number of votes a player gets is determined by how many resources they distribute to a sector compared to the other candidates. For example,

10. Vote choice may depend on the ideological position of candidates. Under the SNTV system, Japanese voters were mobilized mainly by the lure of pork and only marginally by policy issues (FUKUI and FUKAI 1996; HORIUCHI and SAITO 2010; SCHEINER 2006). In addition, it is complicated to consider both ideological space and resource allocation. Thus, to simplify the game, we leave issue/ideological positions of candidates out of the game.

11. If two or more candidates are tied, the winner is randomly chosen.

12. We did not specify what "resource (*shigen*)" means. Rather, we intentionally kept it vague. Resources could be money, time, etc. Before the game began, we explained to students that they would spend their resources by committing to specific sectors. We emphasized that resources are scarce. Therefore, candidates should wisely allocate their resources across sectors to win. We believe that by using a vague notion of resources, instead of concrete notions such as money, time, or name recognition, we did not confuse students.

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 two-ninths. 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

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

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. To secure votes of the sector where multiple candidates compete, the candidates must appeal to the voters or engage in a negative campaign to distinguish themselves from others and win.[13] The competition cost changes the values of elements in a distribution matrix *D*. Because of the cost, the amount of distribution is lowered in each sector (a column of the matrix). The cost is high when the number of competitors is large

13. This is what Tatebayashi (2004, 54–55) calls "friction cost (*masatsu kosuto*)."

in a given sector. As a result, the relative importance of the sectors varies depending on the cost.

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

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

the competition cost is 0.3 in Sector 1,[14] 0.2 in Sector 2,[15] and so on. Taking the competition cost into consideration, we define an adjusted distribution matrix as

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

where we subtract the competition cost from the distribution matrix for positive elements[16] so that all elements in the adjusted matrix are non-negative real numbers.[17]

14. The number of candidates who contribute to Sector 1 is three, so the cost is $0.1 \cdot 3 = 0.3$.
15. The number of candidates who contribute to Sector 2 is two, so the cost is $0.1 \cdot 2 = 0.2$.
16. That is, we do not subtract cost if the allocation is zero in the distribution matrix.
17. If $c = 0$, Candidates 1 and 2 cannot win for certain under MMD-SNTV. For example, suppose that five candidates allocate their resources with $d_1 = \{4, 0, 0, 2\}$, and $d_{3,4,5} = \{4, 3, 2, 1\}$. When $c = 0$, the relative contribution matrix R is

$$R = \begin{bmatrix} 0.4 & 0 & 0 & 0.4 \\ 0 & 0.4 & 0.4 & 0 \\ 0.2 & 0.2 & 0.2 & 0.2 \\ 0.2 & 0.2 & 0.2 & 0.2 \\ 0.2 & 0.2 & 0.2 & 0.2 \end{bmatrix}, \qquad (9)$$

Then, the votes for the candidates V is

Given these rules about how votes are distributed to the candidates, we now turn to describing the rules for district magnitude. We set the magnitude at 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.[18]

Our goal here is to make students understand candidates' strategic calculation and behavior, ignoring the behavior of political parties.[19] Without doubt, political parties matter to electoral competitions. However, one tool

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$$V = R \begin{bmatrix} 40000 \\ 30000 \\ 20000 \\ 10000 \end{bmatrix} = \begin{bmatrix} 16000 + 0 + 0 + 4000 \\ 0 + 12000 + 8000 + 0 \\ 8000 + 6000 + 4000 + 2000 \\ 8000 + 6000 + 4000 + 2000 \\ 8000 + 6000 + 4000 + 2000 \end{bmatrix}, \tag{10}$$

So, all candidates get the same number of votes, and winners are randomly determined. If c = 0.1, in contrast,

$$R = \begin{bmatrix} 0.413 & 0 & 0 & 0.471 \\ 0 & 0.418 & 0.429 & 0 \\ 0.196 & 0.194 & 0.190 & 0.176 \\ 0.196 & 0.194 & 0.190 & 0.176 \\ 0.196 & 0.194 & 0.190 & 0.176 \end{bmatrix}, \tag{11}$$

and

$$V = \begin{bmatrix} 21228 \\ 21109 \\ 19221 \\ 19221 \\ 19221 \end{bmatrix}, \tag{12}$$

Therefore, Candidates 1 and 2 can win for sure. If one of Candidates 3, 4, and 5 changed her strategy alone, she would lose her votes. Because Candidates 3, 4, and 5 are not allowed to communicate with each other, each does not have an incentive to change their strategy.

18. The transfer of resources between candidates is not allowed.

19. The LDP—the party who used to nominate multiple candidates—frequently failed to divide their votes to maximize the winners within a district (Tatebayashi 2004, 47–48).

	MMD-SNTV	SMD-PLURALITY
Number of players (each group)	5	3
Number of groups	3	5
District magnitude	3	1
Duration of each task	3 minutes	
Number of sectors	4	
Population of Sector 1	40,000	
Population of Sector 2	30,000	
Population of Sector 3	20,000	
Population of Sector 4	10,000	
Each player's resource	10	

TABLE 1. Setting of the game.

cannot teach every aspect of the competitions, and so we decided to put political parties aside to keep our game simple. We assume that only one party nominates multiple candidates in a district based on the history of SNTV in Japan (Krauss and Pekkanen 2010). This is not a logical consequence of SNTV. In fact, more than one political party can nominate multiple candidates in a given district.[20] Our setting of the game is just one implementation of many possibilities. Instructors can change the rules of the game in accordance with the purpose of the course they teach. This flexibility is one advantage of our game.

SETTING OF THE GAME

The setting of the game that we carried out is similar to that we described in the previous subsection. Table 1 above 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 a *task*. The students spent three minutes to implement a task.

PROCEDURE

The procedure of the game is practically the same for both SMD and MMD. The only difference is in their seating plans. Figure 1 shows the

20. We would like to thank an anonymous referee for pointing this out.

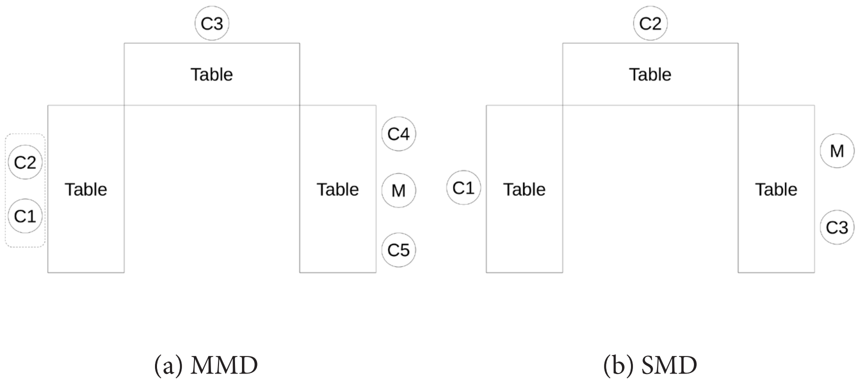


FIGURE 1. Seating plans at a game table.

seating maps we used. C1 to C5 represent the candidates participating in the game,[21] and M represents the game master played by an instructor.

First, we invited 15 students from the "Political Culture class,"[22] randomly assigned them to groups—three in MMD-SNTV and five in SMD, and gave each a player ID.[23] 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.[24] The first ten sheets 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 had elapsed, the game master collected the sheets from the players and calculated the number of votes each player obtained

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

22. We sent out 64 invitation letters, and 50 of the invitees applied to participate. Then, we sampled 15 students randomly from 50.

23. This study was approved by the institutional review board of the Graduate School of Law at Kobe University. IRB number: 2700; date of application: 18 November 2015; Date of permission: 30 November 2015. Title: Verification of Educative Effects using Role-playing Simulation (Role-playing simulation no kyōikuteki kōka no kenshō), representative researcher: Jaehyun Song.

24. Details of the distribution sheets and result sheets can be found in an appendix on the author's website (http://www.jaysong.net).

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)	-

TABLE 2. Expected results.

with R.[25] Then, the results were uploaded to a website.[26] The players opened the webpage and read all the results so far with their own smartphone or tablet device.

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

Lastly, we provided each player with a gift card (500 yen or about 4.2 dollars) as a prize for participation. When giving instructions before the game, we announced that the 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 an advantage over others due to the design of the game, we thought it unfair, and therefore gave all players a gift card.

Results

EXPECTED RESULTS

As mentioned above, the number of sectors in each electoral district is four. Table 2 above 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 to coordinate their resource allocations to maximize their chances of winning 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.

25. The R code is available in an online appendix available on the author's website (http://www.jaysong.net).

26. http://www.jaysong.net/research/apsa_tlc (in Japanese).

Due to the competition cost, it is better to concentrate their resources on a small number of sectors to maximize the number of votes gained by a unit of resource.

Although the resource allocation (d_1=(8,0,0,2), d_2= (0,6,4,0)) does not guarantee the victory 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.[27] In contrast, the other players' winning probabilities are 0.35, 0.35, and 0.36, respectively.[28] 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, only one seat is left for the other three candidates, which is equivalent to the SMD situation competed for by the three candidates.

Unlike MMD-SNTV, no player has the incentive to change their resource allocation under SMD once the allocations converge to those shown in Table 2.[29] However, this 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.[30]

Based on these considerations, we expect the resource allocation to 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_1 = (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

27. The probability of both candidates losing is 0.005 percent.

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

29. Numerical proof is provided in an online appendix available on the author's website (http://www.jaysong.net).

30. The number of possible combinations for Candidates 2 and 3 is 81,796, and Candidate 1 wins 73,639 times with the allocation. The probability of Candidates 2 and 3 winning is about 0.05. We calculated these probabilities in the same way as we did for MMD-SNTV, but we did not sample the strategies.

divide the sectors and distribute the resources intensively to a specific sector. However, they cannot share information due to the rules 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 a larger amount of resources to the less populated sector(s). It is difficult to choose this kind of allocation because Candidates 3, 4, and 5 cannot predict what resources the other candidates will distribute to each sector. As a result, 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 resources on the chosen sectors, ENC is one. For the purpose of illustration, suppose that Candidate 1 provides Sector 1 with five units of resources and Candidate 2 also gives Sector 1 five units. In this case, ENC is 2 for Sector 1.[31] If Candidate 1 transfers three units and Candidate 2 distributes seven units, ENC is 1.72.[32] When only one candidate provides a sector with the resource, ENC is 1.[33] 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

31. $$\frac{1}{0.5^2 + 0.5^2} = 2.$$

32. $$\frac{1}{0.3^2 + 0.7^2} = 1.72.$$

33. $$\frac{1}{1.0^2 + 0^2} = 1.$$

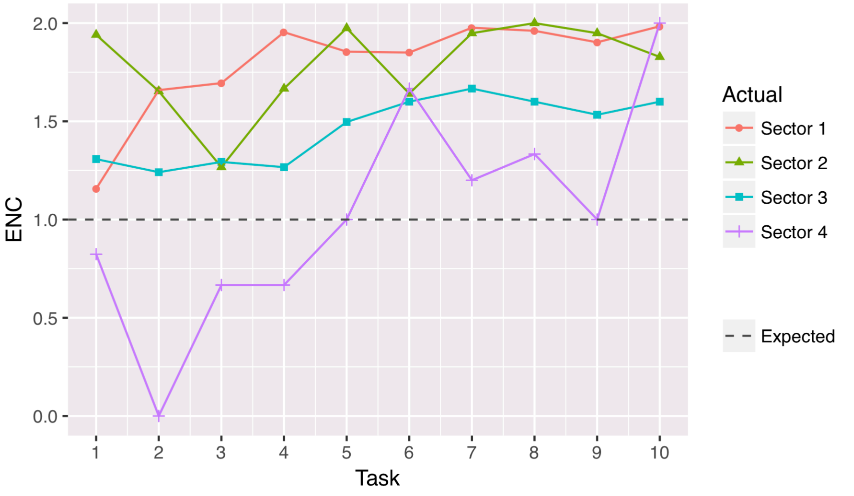


FIGURE 2. Result of the game: Candidates 1 and 2 under MMD-SNTV.

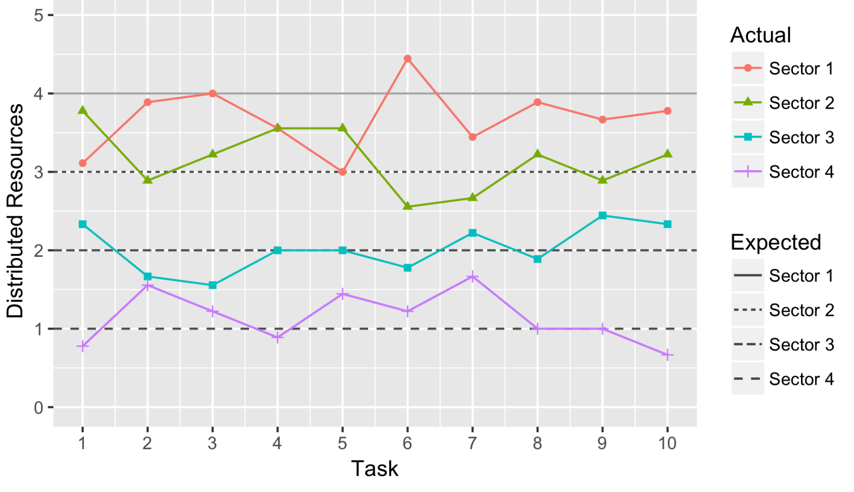


FIGURE 3. Result of the game: Candidates 3 through 5 under MMD-SNTV.

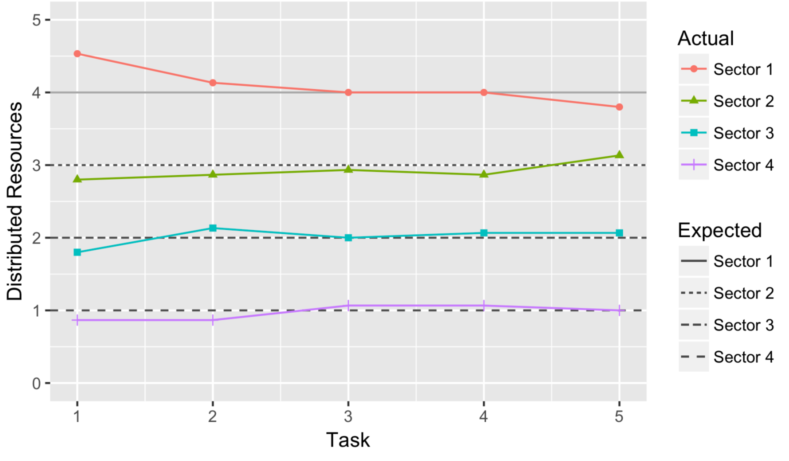


FIGURE 4. Result of the game: SMD.

ENC. The four lines show the sectors' ENC in each task, and the horizontal dashed line clarifies where ENC equals one. The results shown in Figure 2 contradict with our expectations 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 expectations.

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. The four lines in the figure are the amounts of the resources the sectors received. It shows that these candidates adopted 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 expectations.

Overall, our expectations were 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 the discrepancy between our expectations and the results in the next subsection.

Figure 4 above 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 chances to win because Candidates 1 and 2 deviated from our expectations.[34] Although this 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 the students who were 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 each other. Since they simulated only ten elections, they may have thought that it could be risky to provide large sectors with none of the resources. Before starting the game, we told the students that only three winners would get the bonus to stimulate their motivation. The maximum number of elections 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 Sectors 3 or 4, which are relatively small sectors, but they were not ready to discard Sectors 1 or 2, which are 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 present 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.[35] The participants anonymously answered these questions.

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

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

35. All questions were asked in Japanese.

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 somewhat 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 to 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 the consequences of different electoral systems, including MMD-SNTV and SMD. During the class, he talked about how district magnitude affects 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 the "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 believe that our method works.

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 tested 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.

$$U_{\text{class}} = E\ \text{verbal}\ \cdot \tag{6}$$

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

U_{class} represents the degree of understanding about electoral systems among the students who did not participate in the game. U_{class} is that of those who participated in both the class and the game. 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.[36] We cannot measure the pure effect of the game by simply subtracting Equation 6 from Equation 7.[37] However, if E_{game} and E_{verbal} are non-negative, U_{game} must be larger than U_{verbal}.[38] If our game did not affect the learning outcome ($E_{\text{game}} = 0$), U_{game} should equal U_{verbal}. That is, the role-playing game improves students' learning if $U_{\text{game}} > U_{\text{verbal}}$.

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 participated more actively in the game, enjoyed it

36. 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, we assume a positive β does not undermine our argument below.

37. 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 participated 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.

38. 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 $-\frac{E\text{verbal} + E\text{game}}{E\text{verbal} \cdot E\text{game}}$. However, β defined in this way can cause a serious problem. If Egame 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.

	PARTICIPATION	ENJOYMENT	HELPFUL
Mean	3.60	3.60	3.21
Standard deviation	0.51	0.51	0.80

Note: N = 15

Larger value means more positive response.

TABLE 3. Summary of post-game evaluation.

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 shows how effective the game was. As mentioned above, we asked three questions that measure students' subjective degree of understanding of: M + 1 rule, consequences of district magnitude, and the relation between the electoral system and factionalism.[39]

Then we compared the students in the control group with those in the treatment group. If our method was effective, the proportion of "understood" should be higher in the treatment group than in the control group. Furthermore, the other points—M+1 rule and the relationship between the electoral system and factionalism—must have a 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 a *t*-test. We assume that the degrees of understanding about the effect of district magnitude are generated as follows:[40]

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

39. The class had some fifth-year and graduate students. We excluded them from our analysis. Furthermore, the students who participated in the pilot game were also excluded.

40. The parameters of each normal distribution are mean and standard deviation.

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.

TABLE 4. Summary of post-lecture evaluation (degree of understanding).

U is the degree of understanding about the effects of district magnitude, and it follows normal distribution with means of μ_g and standard deviations of σ_g. Students in the treatment and control groups have different parameters of normal distribution. μ_1 and σ_1 are parameters for the treatment group. μ_2 and σ_2 are those of the control group. δ is the difference between μ_1 and μ_2. If δ is positive, our game is considered effective.[41]

Figure 5 shows the posterior distributions of μ and δ.[42] Posterior distribution shows the estimated distribution of parameter given data. A convergence index, $\hat{R}$, of all the parameters are less than 1.1, and 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 the subjective degree of understanding in the treatment group is higher than that in the control group by 0.2. To check how effective the game was, we present the posterior distribution of δ in Panel (b). The largest 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 a probability of 0.96.

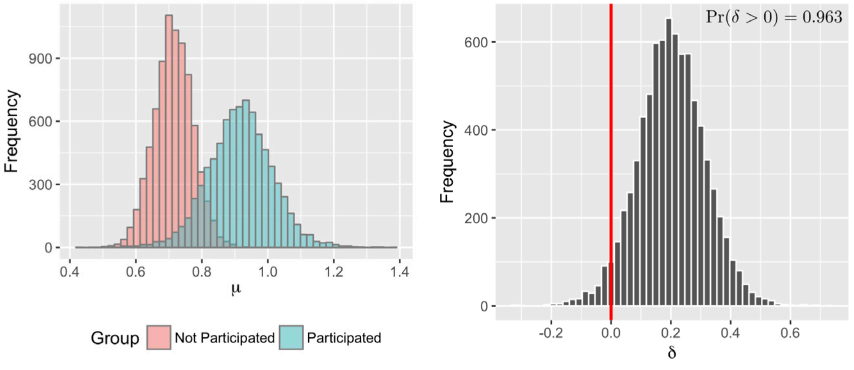
In short, compared to students who only listen to lectures, our game players achieved a better understanding of the effects of electoral systems.

Conclusion

In this article, 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;

41. We used R 3.4.1 (R Core Team 2015) and rstan 2.16.2 (Stan Development Team 2017) to estimate the parameters.

42. The posterior distributions of σ are shown in an appendix available on the author's website (http://www.jaysong.net).



(a) Posterior Distribution of μ (b) Posterior Distribution of δ

FIGURE 5. Posterior distributions of the estimated parameters.

they enjoyed playing it and felt it was useful. Furthermore, our game improved the students' understanding of the effect of district magnitude.

The game introduced in this article focuses on district magnitude. The role-playing game is useful in particular when teaching about electoral systems that no student in class has experienced before, such as MMD-SNTV. To maximize the effect of the game, it is essential to deliberately design game settings and procedures. 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 the limitations of our game and suggest how we can overcome these. In the game under the MMD-SNTV rule, no player who was assigned to the same party with another adopted the best allocation of resources. Although it is not difficult to alleviate this problem in theory, in practice some difficulties exist. First, students need learning periods. We could get 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.[43]

43. 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.

Second, students might be shy. We could obtain better results if we made Candidates 1 and 2 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 cases, 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 as Candidates 1 and 2.

Third, we should objectively evaluate how the game helps students understand the effects of electoral systems on politicians' behavior. In this study, we have shown that our game promoted the participants' subjective understanding. To demonstrate whether the game in fact enhanced their understanding, we should have conducted an exam after the game. Next time we use this game in class, we will objectively evaluate the effects with an exam.

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