The Experiment of COMMONS Game and the Environmental Education

Masashi KAWAGUCHI\(^1\) and Norio BABA\(^2\)

\(^1\)National Institute of Technology, Suzuka College, Shiroko Suzuka Mie 510-0294, Japan
\(^2\)Osaka Kyoiku University, Asahi-ga-Oka, 4-698-1, Kashiwara City, Osaka Prefecture, 582-8582, Japan

Keywords: Gaming, COMMONS game, Environmental education.

Abstract. Gaming has been recognized as a new method of solving problems. It is widely known as a method of solving problems which is to solve by simulation. We conducted the COMMONS game and reported its environmental educational effect. The COMMONS game is one method to environmental education using five kinds of cards and environmental state. In the experiment, seven groups of 42 students would attend the game, one group consisting of six players. A good solution was obtained. Additionally, students learned Improvement of environmental conditions and not pursue only their benefits. We realized that this experiment resulted in a desirable educational effect. In addition, we evaluated the results of the COMMONS game.

Introduction

In recent years, gaming has been recognized as a new method of solving problems. It is widely known as a method of solving problems which is to solve by simulation. It has been used for many fields such as learning, education, collaboration, training, decision-making, playing, and etc. [1]. Along with the invention of many kinds of games, keep working on the continuous effort has been put forth in order to make existing games more interesting [2].

In this study, we conducted the COMMONS game and reported its environmental educational effect. The COMMONS game is the kind of “Education Gaming”. Education Gaming attempts to educate and train all participants. For example, in one such game there was an assumption that participants did not have much interest in economics. After playing the game for a few hours, the participants noticed their lack of basic knowledge and felt the need to learn economics more deeply. The result was that this game had a very significant educational benefit [3].

The management game is a kind of Education Gaming which focuses on training. It is made for people working in a middle-class stage of companies. When a person is promoted to a position that has a direct impact on the management of a company, there is the possibility of significant “Risk”. This is because when a person who lacks experience is entrusted with important business, he or she may not know the appropriate action. To help in such a situation, playing a game which simulates the management of the company again and again will help enable the person to master "how to manage the company" without entailing a greater risk more practical methods.

COMMONS Game

The COMMONS GAME [4], one of the most famous games confront serious and heavy environmental issues in this world and earth, was invented by Powers et al. around 1980. Since we have to share the limited resources in this world, such as foods, animals, fishes, and plants (commons), careful use of commons is required. The COMMONS GAME is very effective in developing discussions about this environmental issue. Fig. 1 shows the arrangement of original COMMONS GAME.

In the following, we explain the little overview about this game. In Fig.1, six players are sitting around the table according to the game director’s instructions. After explaining the game rules in briefly, the game director announces the players try to getting higher score by choosing one card from
the five type colored (Green, Red, Black, Orange, Yellow) cards in each round. In each round, players hide their cards behind a shield of each cardboard, not to show their each cards to other players.

![Diagram of Commons Game](image)

**Figure 1.** The arrangement of original COMMONS GAME.

The following shows the relationship between the meaning of the five color cards and the player's score.

1) A Green card means the use of self-owned (exclusive) common property. The highest score can be obtained, but using this card too much will cause the environment to deteriorate and the score will gradually decrease.

2) A red card means the collaborative use of common property. The score is about half of the Green card.

3) A black card means giving the penalty of -20 points who issued the Green card player. However, black card player has to lose 6 points divided by the number of black card players.

4) A yellow card means the escape from the common property problem and gets 6 points.

5) Orange card means promoting the cooperative use of common property at the expense of self. 10 points will be added to the player who chose the Red card, and lose 6 points divided by the number of the orange cards player.

Game players' attitude to environmental protection and the attitudes requiring high scores change the state of environment. Overuse of Green Cards degrades the resource environment and reduces the score of Green and Red Cards. Game director announced 60 rounds playing to each player, but the game ends when 50 rounds is finished. After every eight rounds, there is a three-minute conference time. The player discusses the progress, strategy and future developments about the game.

Using three-minute conference time, if all players agree to help prevent environmental degradation, the overall score increases. However, if many players pursue only their own benefits and abuse the Green Card, environmental condition becomes serious. In particular, the environmental value
becomes a large negative value. On the other hand, if environmentally friendly game is implemented, environmental values will be positive, and Green Player and Red Player can expect more points.

We explained a brief introduction about of the COMMONS GAME. The further details are referred to [4].

**The Parameter of COMMONS Game**

Table 1 shows the score by Red and Green card in each environmental state. In the case environment state is 0, 3 green cards and 3 red cards are submitted. The score of the player who submitted the Green Card and Red Card is as follows. We focus on the R column to see the value in the (Number of Red Cards + 1) line. The score of Red Card and Green Card by changing environmental conditions.

| State: -8 | State: -1 | State: 0 | State: 1 | State: 8 |
|----------|----------|----------|----------|----------|
| R    | G    | R    | G    | R    | G    | R    | G    | R    | G    |
| -9    | -2    | -10  | 2    | -70   | 27  | 74  | 29  | 76  | 31  | 78  |
| -8    | 4     | -6   | 8    | 4     | -4  | 8   | -2  | 10  | 0   | -   |
| -9    | -2    | -4   | 10   | 35    | -   | 50  | -   | -   | -   | -   |

In this case, the score of Red Card player is “44”. And the score of Green Card player is “106”, it is the adjacent value of State:0 in Table. From Table 1, the score of Red Card and Green Card players increases as the environment improves. On the other hand, the score decreases if the environment degradation. In the worst -8 state, the score is almost zero [5].

**Commons Game on the Students’ Class**

In the case of the conventional method, the game director has to deal with very complicated tasks such as checking the player’s card and the environmental state in every round. In addition, it is impossible to display the score and summary of each player in the short conference time. In addition, it is difficult to provide various data such as graphs in an easy-to-understand format for the follow-up session after the game to each player. To solve these problems, many methods have been proposed [6] [7]. By using personal computer system, and player can game more easily [8].

In this experiment, we use Microsoft Excel [9] [10]. The game director is unnecessary because each player can input their card’s color to keyboard. We show the input display of Excel window in Fig. 2. Since the score can be displayed by personal computer immediately, the game can proceed efficiently. Also, there is no need to use a special system, only needs the Excel application. Furthermore, since the gaming results are saved in CSV format, it is easy to analysis the gaming result data. It is also possible to correct past data when reflecting on the progress of the game [11].

![Figure 2. The display of excel when 1st round is finished.](image)
Results and Conclusion

There are 6 players in one group. In this experiment, we carried out by 7 groups because there are 42 students in one class. The player can compete for scores within each group. In addition, player can compare the environmental condition and total score with other groups. It is expected to increase the effectiveness of the game.

The time required is about 70 minutes until the end of the 50th round. The game was carried out more efficiently compared to the previous method, required time is about 3 hours. In addition, the highest score is 3168 points among all 42 players of 7 groups which is a significant increase compared to the conventional cases. Table 2 shows the total score, maximum score, and environmental state at the end of the 50th rounds for each group A to G.

Table 2. The score of Red Card and Green Card by changing environmental conditions.

| Group | Amount Total Score | Maximum Score of Player | Environmental State |
|-------|--------------------|-------------------------|---------------------|
| A     | 16169              | 3168                    | 2                   |
| B     | 5596               | 1177                    | 0                   |
| C     | 7989               | 1420                    | 0                   |
| D     | 7754               | 2841                    | 1                   |
| E     | 13920              | 2975                    | 1                   |
| F     | 13369              | 2706                    | 1                   |
| G     | 6384               | 1880                    | -1                  |

In the previous experiment, the average score of each player was about 1000, the total amount score by 6 players was about 6000. The result of this experiment, the score is significantly higher than the average score of previous experiment. One reason is each score of all the group are presented to everyone when the end of 8 round and 24 round. Each player can compete their scores and attend the game more seriously. Participating students as the player were able to learn about environmental issues through practical methods and bargaining by gaming. Figure 2 shows the gaming results of Group A and Group B. The horizontal axis of each graph means number of round. The vertical axis means the score of each player. This means the gaming results of each groups are not the same but each group has its own characteristics. It is interesting that different strategies were taken for each group. Participants learned about environmental issues through practical methods and bargaining. However, the game becomes monotonous if the cooperation is too strong between the players. To solve this future problem, we have to adjust the parameter to suitable value. It is also a future scope to improve the rules of the COMMONS game for environmental education.
References

[1] Shubik, M., Games for Society Business and War: Towards a Theory of Gaming. Elsevier, Amsterdam, 1975.
[2] Hausrath, A., Venture Simulation in War, Business, and Politics. McGraw-Hill, New York, 1971.
[3] Duke, R.: Gaming: The Future’s Language. Sage Publications, Thousand Oaks, 1974.
[4] Powers, P., Duss, R., Norton, R.: THE COMMONS GAME Manual. In: IIASA, 1980.
[5] Baba, N., Uchida, H., Sawaragi, Y., A Gaming Approach to the Acid Rain Problem. Simulation & Games 15,3(1984), 305-314.
[6] Baba, N., PC-9801 Personal Computer Gaming System. Nikkan Kogyo Publishing Company, 1986.
[7] Baba, N., Jain, L.C., Handa, H., Advanced Intelligent Paradigms in Computer Games. Springer, Heidelberg, 2007.
[8] Baba, N., Handa, H., Kusaka, M., Takeda, M., Yoshihara,Y., Kogawa, K., Utilization of Evolutionary Algorithms for Making Commons Game Much More Exciting. Proc. KES2010, Springer-Verlag, 2010.
[9] Kawaguchi, M., Atsumi, K., Baba, N., The Experiment of Sweden Game and the Effect of Students Education, Frontiers in Artificial Intelligence and Applications Volume 243 (2012) 1972-1980.
[10] Kawaguchi, M., Kanematsu, H., Baba, N., The Experiment of Sweden Game and the Evaluations of Gaming Result, Procedia Computer Science 60 (2015) 1170-1177.
[11] Kawaguchi, M., Baba, N., The Efficient Method of COMMONS GAME Experiment and the Effect of Students Education, JASAG2016 (2016) 40-44.