



Development and Pilot Application of an Educational Board Game for Climate Change Education

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Introduction (1) Climate change education

- Recent changes across the climate system are unprecedented in scale and diversity. The obvious cause is **human activity** (Pörtner et al., 2022).
- Risks caused **by climate change threaten human life** today, so climate change education for future generations is more urgent than anything else (Woo & Nam, 2012).
- Educational policies and curricula should enhance students' knowledge and understanding of the causes and effects of climate change and strengthen **their skills, values, and attitudes for combat climate change** (Wals, 2012).

Introduction (2) Action-oriented Science Education

- To bring about change, **action is required**. Knowing alone is not enough.
- **SL (Scientific Literacy)**
 - Vision I: scientific content and scientific processes to learn about corresponding applications later
 - Vision II: contextualizing scientific knowledge for giving its use in life and society meaning
 - **Vision III**: philosophical values, politicization and critical global citizenship education
- Children should be educated to become **civic citizens**. School would encourage students to become free, **responsible actors in society**, with a developed individuality – cognitively, morally, as well as aesthetically (Burman 2014).
- However, it is much **harder to change attitudes and let people take action** for climate change than it is to understand knowledge about climate change.

Introduction (3) Gamification

- Gamification is a term that has been used since 2002 by British game developer Nick Pelling and is a combination of ‘game’ and ‘~fication’ (Christians, 2018).
- According to Kapp (2012), gamification “is [more broadly] using game-based mechanics, aesthetics, and game thinking to engage people, motivate action, promote learning, and solve problems” (p. 10).
- Gamification promotes positive outcomes in terms of learner engagement (Bouchrika et al., 2021), persistence (Morris et al., 2013), **spontaneity** (Tomaselli et al., 2015), and cognitive abilities (Sudarmilah & Arbain, 2019) by providing enjoyment.

Co-project

Research Objectives

- Develop a science education program using board games to help students develop ‘**climate change citizenship(氣候變化市民性^{KR}/公民權^{TW})**’ to respond to climate change.
- Confirm the effectiveness of the new science education program through the pilot test.
- Introduce this program and board game to Korea and Taiwan junior high schools(中學校^{KR}/國中^{TW})



Educational Board Game for Learning Science

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Action-oriented Science Education

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Research Questions



1. What is climate change citizenship?

- The definition of climate change citizenship was defined, and
- 3 main components was drawn through literature review.

2. Development of a new board game and related science education program

- What are the design principles of board games for climate change education?
Based on the definition of “**climate change citizenship**,” set the three design principles.
- Development a new board game and do pilot plays with board game experts

3. Pilot research for verification

- What changes were found in the students’ climate change citizenship?
New board game was introduced to 24 high school students.

Results – 1. What is climate change citizenship?

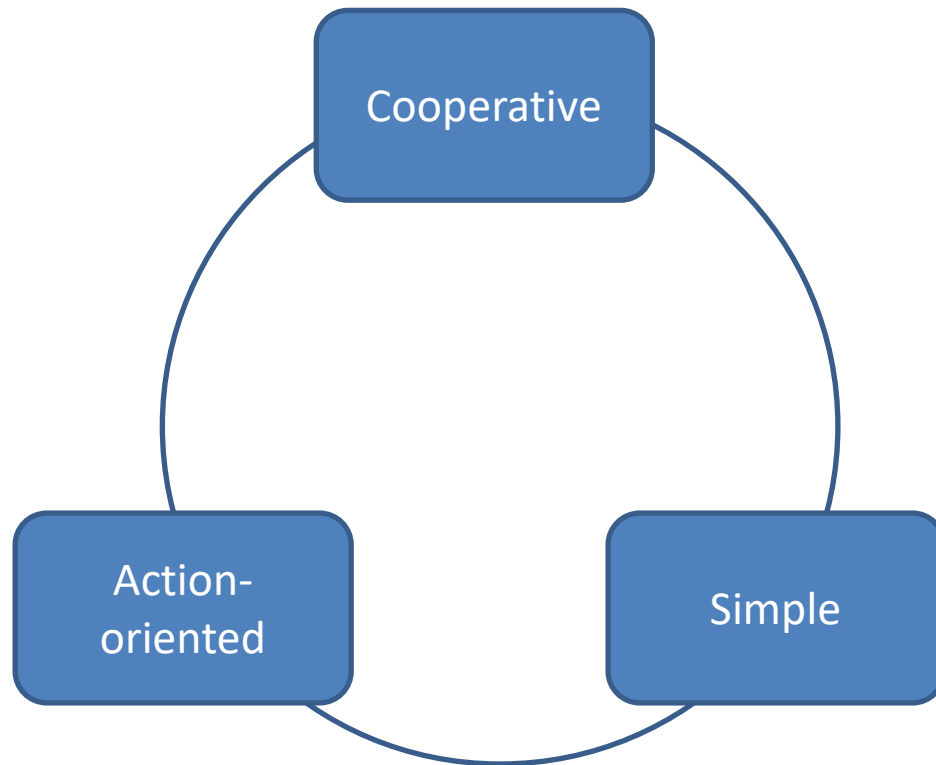


Components		Contents
Understanding of the interaction between STS(science and technology and society)		Ability to understand and explain the impact of interactions between STS based on critical thinking
Value judgments and decision making	Moral and ethical judgment	Ability to morally and ethically judge social issues arising from the development of science and technology based on a sense of social responsibility
	Action strategies	Ability to arrange action strategies through predict short- and long-term and potential impact on social issues related to science and technology around oneself
Socioscientific issues efficacy		A belief that one can participate in resolving social issues through personal and social action.

Results

2. Development of board game and education program

2-1. What are the **design principles** of board games for climate change education?



- Based on the review of diverse board games, we set three design principles.
- Cooperative
 - All players become one team. So, either all win or all lose.
- Action-oriented
 - Points are earned through climate change response actions.
- Simple
 - Due to lack of time in the curriculum, how to play the game should be understandable within 40 min.

Results

2. Development of board game and education program


Development of the board game





- 1. 1 * game board
- 2. 7 * country cards
- 3. 50 * climate action cards
- 4. 15 * disaster cards
- 5. 6 * green cube
- 6. 6 * red cube
- 7. 4 * player miniatures
- 8. 6 * green token
- 9. 1 * makers for a current player
- 10. 1 * coin box
- 11. 1 * 123 dice




1. There are four players.
2. Each player can be one country.
ex) A- Taiwan, B- Korea, ...

 **韓國**

 5200萬 (人)

 1.6萬億 (美元)

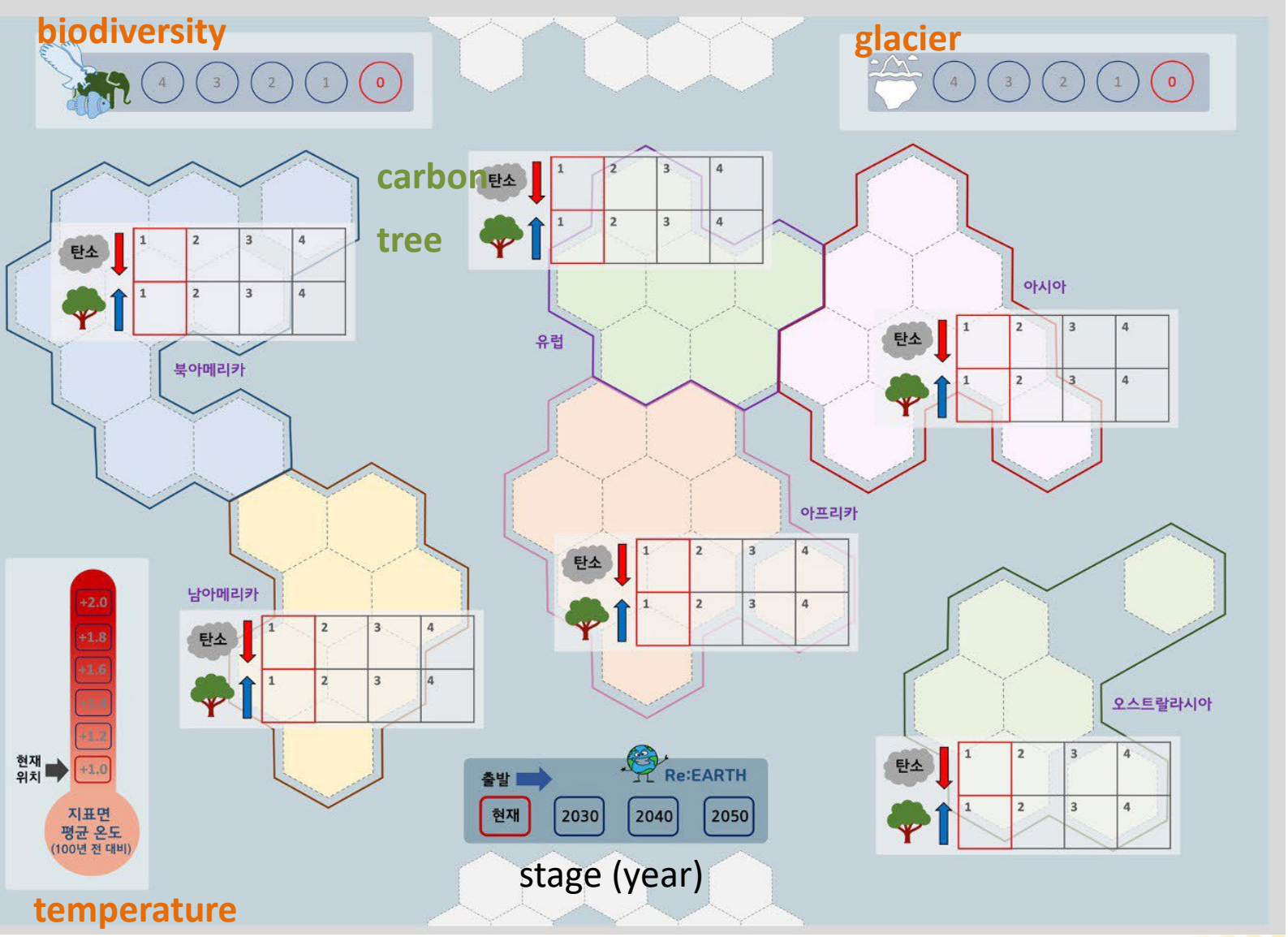
 7億 (噸)

 **30**

在你的回合中，你可以一次抽取兩張氣候行動卡。

each country have different amount of money from the beginning (based on GDP)

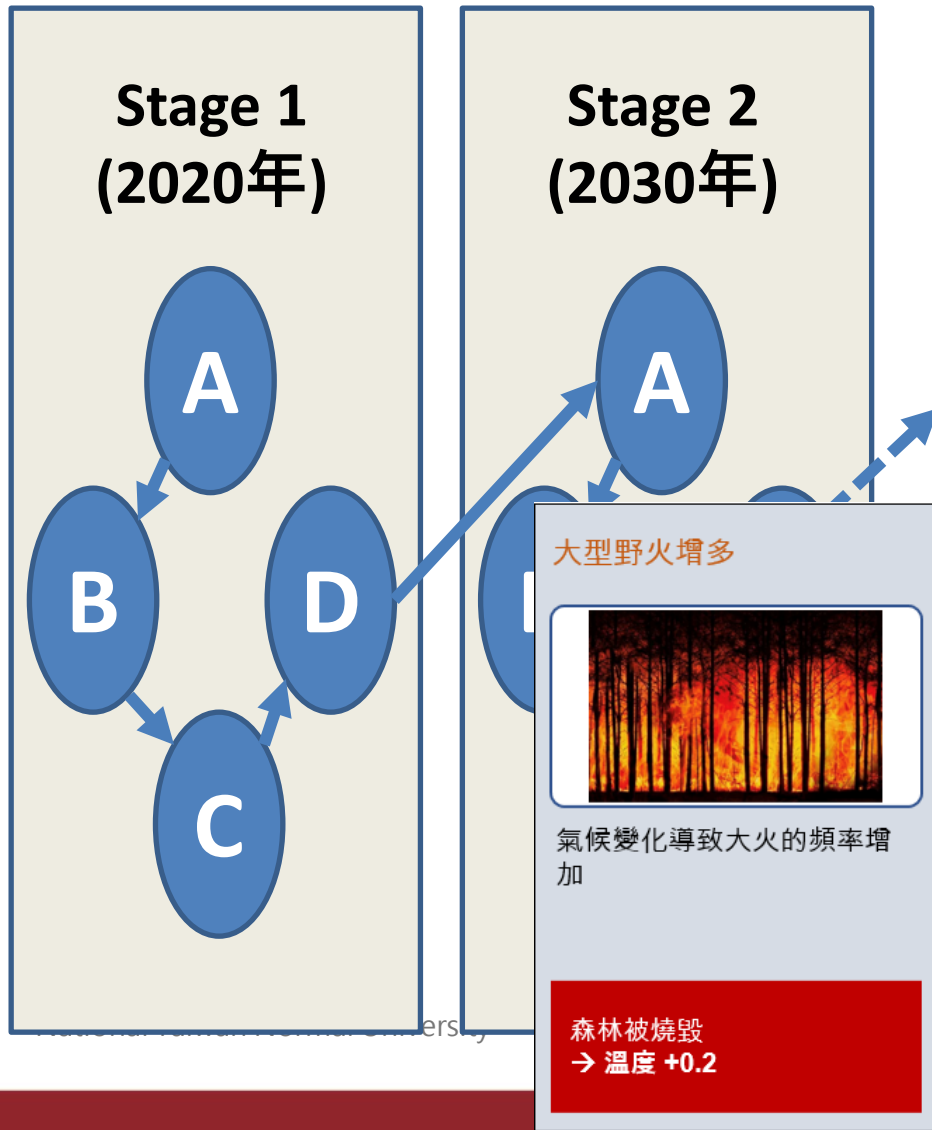
3. (2020, 2030, 2040, 2050)




■ Players need to manage **NTNU** five kinds of points to win the game together

1. earth's temperature
2. earth's biodiversity
3. earth's glacier
4. each continent's carbon

WIN	LOSE
All continents' carbon and tree reach 4 points.	Earth's temperature, biodiversity, glacier reach limits.



縮短淋浴時間



通過減少淋浴時間來減少用水量 → 減少不必要的能源使用

2

- [Stage start]
 1. Each stage, draw one diester card together
- [Each Player's Turn * 4]
 1. Each player draws one 'action card'
 2. explain to other players what the action is.

If a player participate an action

3.

He should pay \$	He can contribute to combat climate change. Select one => glacier +, temperature -, biodiversity +, cabon -, tree+
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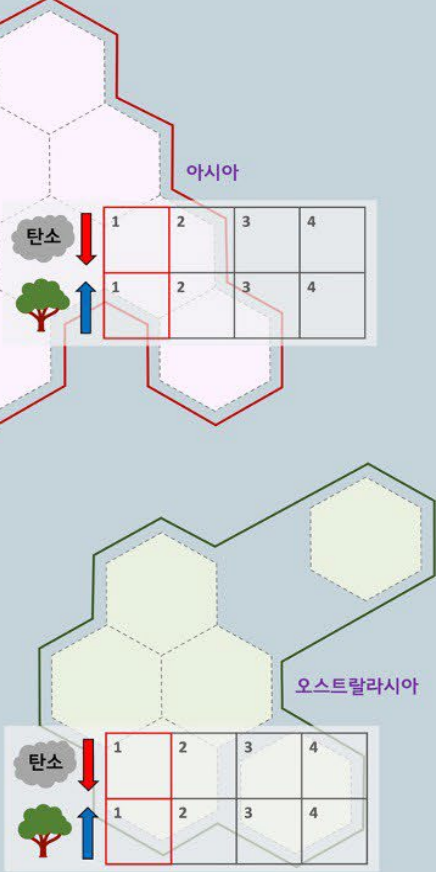
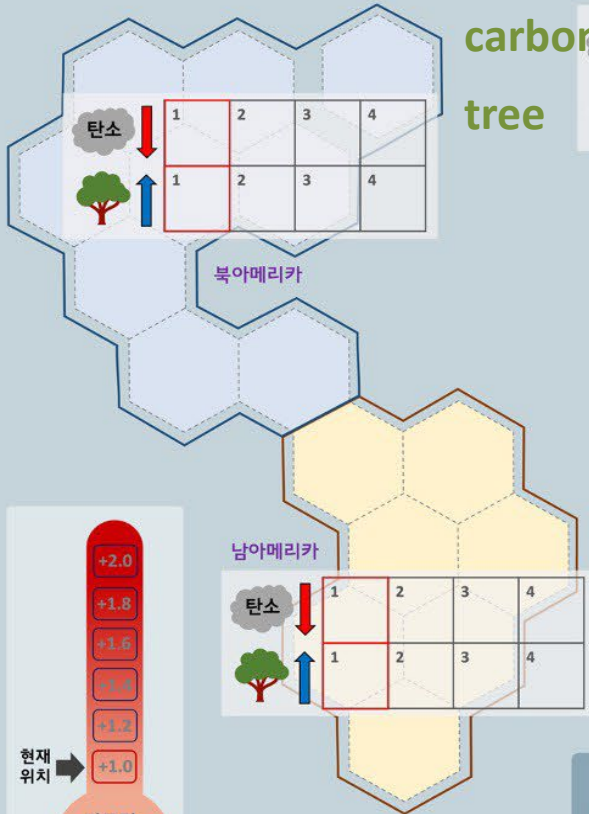
biodiversity



glacier



carbon tree



stage (year)

temperature

During the game, all players need to manage five kinds of points together.

Kinds of point	Worse	Better
Earth's - biodiversity - temperature - glacier	going worse due to "disaster card"	change better due to "climate action card"
Each continents' - carbon - tree		change better due to "climate action card"

Results

3. Development of board game and education program



Developing a related education program

Period	Contents
1 (50min)	Introduction of this program, Grouping, Knowledge about climate change
2 (50min)	Playing board games - explanations about the rules of the board game - reflection about their playing
4 (50min)	Playing board games - reflection about their playing - making their own action cards & planning their climate actions
5 (50min)	Discussion and presentation about their action card and climate action plans

Results

3. Development of board game and education program

For cultivating climate change citizenship:



Components		Related components in the board game
Understanding of the interaction between STS(science and technology and society)		Explain disaster card(including natural and human-made) – containing complex natural / artificial phenomena
Value judgments and decision making	Moral and ethical judgment	Not a competitive game – Either all win or all lose. Each country has different abilities (money), but everyone must work together to win.
	Action strategies	Explain action card – understanding possible actions strategies Making their own action card Planning their climate actions
Socioscientific issues efficacy		Action cards contain only things that can be taken at their level.

Result 3 Pilot research for verification

- Research Design
 - Extracurricular program (afterschool)
 - Participants – 24 Korean Highschool students (高等學校), 4 persons * 6 groups

- Raw data
 - Video recording
 - Deep Interview (2 per group = 12 persons)



Result 3 – Pilot research for verification

Understanding of the interaction between STS

- 1B: (The problem is caused by rich countries.) It was difficult to combat climate change without **the participation of rich countries**. However, rich countries will not want to spend money.
- 1D: I felt **that man-made changes had disrupted the balance of the ecosystem**. Nature interacts with each other, and humanity belongs to it.

Value judgments and decision making

- 1D: Our country has caused an outbreak of climate refugees. We have a responsibility to take care of them. Since Korea is a better-off country than other countries, **we should accept more refugees**.
- 2D: Isn't there such a thing as the providence of nature? Nature should be left as it should be, but if we go against the providence, problems will inevitably arise.
- 5C: I am fortunate enough to enjoy abundance, but **I am sorry that climate refugees** are only suffering.

Socioscientific issues efficacy

- 1D: Before playing board games, I thought that no matter how hard I tried to participate recycling, it would do nothing to deal with climate change. However, I realized that little things came together and made this result (climate change).
- 2D: I think we should be involved in tackling climate change. Even if I speak to our congressman, he will ignore my voice. However, I can support politicians who propose relevant (eco-friendly) policies.
- 2D: Among the action cards, there were many things that individuals could do. I think from me I should do it.
- 3A: **I learned what to do through action cards**. I think I will be more active in the future.

Conclusion



- The science education program through gamification made students
 - understand the STS interaction related to climate change,
 - empathize with the value of coping with climate change,
 - and feel that they are effective in solving this climate change.
- Limitations & Future Study
 - This study, as a pilot study, relied on student interviews to find out the changes caused by gamification.
 - In the future study, more sophisticated evaluation tools will be developed to obtain quantitative data. And the quantitative results will be supplemented with qualitative analysis.
 - And we will introduce the same program for Taiwanese and Korean students and compare the differences between two countries.

} **climate change citizenship**

Thank
you