# From Global Climate Action Policies to the Future Daxi Community Board Game: A Case Study of How SDG 13 Climate Action Links The State and the Youth in Taiwan

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## INTRODUCTION: OVERVIEW OF CLIMATE CHANGE

The record-breaking heat of 2022 has made the effects of climate change more no-ticeable than ever. France experienced its hottest May on record. Britain was under a "red" extreme heat warning for the first time in its history. In South Asia, summer arrived ahead of schedule, bringing temperatures above 120°F (50°C). The United States is also reporting blistering temperatures. Taiwan is enduring rising sea lev-els, unexpected heavy rainstorms, regular extreme heat, and an increase in severe typhoons. Rainstorms and typhoons combined with fragile geological conditions and poor recovery capacity create the potential for mudslides. Prolonged droughts and extremely high temperatures are harmful to agriculture, industries and health. There is therefore an urgent need for governments to promote education systems that are oriented towards climate awareness and the United Nations' Sustainable Development Goals (SDGs)[1].

Established in 1988, the Intergovernmental Panel on Climate Change (IPCC) provides policymakers with scientific assessments about climate change[2]. It pro-poses three core issues to focus on in the fight against global warming: science (understanding and projecting climate change), mitigation (reducing greenhouse gas emissions), and impact and adaptation (preparing for climate impacts that are now unavoidable). Since the mid-1990s, the United Nations Climate Change Conferences (UNCCC) are yearly assessment meetings for the United Nations

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1. The United Nations. The 17 Goals. (https://sdgs.un.org/goals).
2. The Intergovernmental Panel on Climate Change. (https://www.ipcc.ch/).

Framework Convention on Climate Change (UNFCCC)[3]. IPCC committees negotiated international environmental rules for governments and businesses based on the assessment reports. From the perspective of adaptive governing SDGs, researchers argue that Climate Action as SDG 13 impacts most of the other SDGs. Zhenmin and Espinosa (2019, 495)[4] point out that mitigating climate changes offers positive preventions to slow down the worsening of most of the other SDGs, especially SDG 1 Poverty, SDG 2 Hunger, SDG 3 Health, SDG 10 Inequality, and SDG 14 Below-water and SDG 15 On-land ecosystem preservation.

Young people are at the centre of climate action. They are fighting the ecological crises and problems caused by greenhouse gas emissions, environmental hazards and pollution (Beukes 2021:1, Chersich et al. 2019:615)[5]. Sweden's Greta Thunberg challenged world leaders for not taking immediate action to mitigate climate change at the 2018 UNCCC and the 2021 Youth4Climate summit. In November 2018[6], young people joined the Friday for Future school climate strike movement.[7] Scholars and activists have supported the gamification of climate action. In Taiwan, the climate actions by young people have led educators and educational policymakers to endorse climate-safe teaching, activities, and civic engagement. National and international climate actions have influenced the rising generation. Scientists and policymakers argue that education is critical to bridging the science-action gap of climate change (Moser and Dilling 2012, O'Brien 2013)[8]. Our research team advo-

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3. What are United Nations Climate Change Conferences? (https://unfccc.int/process-and-meetings/conferences/the-big-picture/what-are-united-nations-climate-change-conferences); Climate Action Demands Intergenerational Solidarity. (https://unfccc.int/).

4. Zhenmin, L. and Espinosa, P. 2019. Tackling climate change to accelerate sustainable development. Nature Climate Change, 9(7), 494-496.

5. Beukes, J. W. 2021. Seen and heard: the youth as game-changing roleplayers in climate change and environmental consciousness. Chersich, M. F., Scorgie, F., Wright, C. Y., Mullick, S., Mathee, A., Hess, J., and Rees, H. 2019. Climate change and adolescents in South Africa: The role of youth activism and the health sector in safeguarding adolescents' health and education. South African Medical Journal, 109(9), 615-619.

6. Greta Thunberg's full speech at UN Climate Change COP24 Conference. (https://www.youtube.com/watch?v=VFkQSGyeCWg); Greta Thunberg says world leaders' talk on climate change is blah blah blah. (https://www.washingtonpost.com/climate-environment/2021/09/29/great-thunberg-leaders-blah-blah-blah/); Youth4Climate Empowering the Next Generation. (https://www.connect4climate.org/initiatives/youth4climate).

7. Timeline: Greta Thunberg's rise from lone protester to Nobel favorite. (https://www.reuters.com/article/us-sweden-nobel-thunberg-timeline-idUSKBN1WI1RT).

8. Moser, S. C. and Dilling, L. 2011. COMMUNICATING CHANGE SCIENCE:-CLOSING ACTION CLIMATE. In The Oxford handbook of climate change and society, p. 161; O'Brien, K. 2013. Global environmental change III: Closing the gap between knowledge and action. Progress in Human Geography, 37(4), 587-596.

cates that building youth-friendly and gamified public and private partnerships are critical to engaging the youth in climate action (Flood et al. 2018, Rajaen and Rajanen 2019)[9]. We present a case study of youth partnerships for creating the Future Daxi community-based board game to disclose the policy-to-action climate action experiment carried out by a rural vocational high school in partnership with an urban university. The scope of this paper ranges from global climate action to local knowledge transformation; from a state's governing systematic restructures to individual learning; and from governmental policymaking to students' game design.

Our classroom-based research follows the climatological pedagogy of gamification and serious-game design (Beukes 2021, Ouariachi et al. 2020, Fernández and Ceacero-Moreno 2021)[10]. Our paper consists of three sections: the SDG 13 education platform; the climate action youth competition and the Future Daxi team and the design of the Future Daxi board game; and post-gaming reflections. In Section I, we introduce the Climate Change Action Education Platform (CCAE Platform) as the context for readers to understand how the Taiwanese government's Ministry of Education (MOE) has incorporated climatological sciences into the national education systems[11]. Section II introduces the Climate Change Action Contests held by the CCAE Platform and the prize-winning Future Daxi team. The game was developed by a rural vocational high school, Jhih Shan High School (JSHS) in Daxi Taoyuan, in partnership with the Graduate Institute of Building and Planning at National Taiwan University (henceforth NTU)[12]. We explain how the team prepared for the project. In Section III, we explain the gamification of the Future Daxi board game, which won third prize in 2020. We examine how the team integrates Daxi sociocultural and environmental knowledge into the board game. In the conclusion we use the JSHS-NTU design journey and post-gaming reflections to re-examine Taiwan's CCAE

9. Flood, S., Cradock-Henry, N. A., Blackett, P., and Edwards, P. 2018. Adaptive and interactive climate futures: systematic review of 'serious games' for engagement and decision-making. Environmental Research Letters, 13(6), 063005; Rajanen, D., and Rajanen, M. 2019. Climate change gamification: A literature review. GamiFIN, 253-264.

10. Beukes, J. W. 2021. Seen and heard: the youth as game-changing roleplayers in climate change and environmental consciousness; Ouariachi, T., Li, C.-Y., and Elving, W. J. 2020. Gamification approaches for education and engagement on pro-environmental behaviors: Searching for best practices. Sustainability, 12(11), 4565; Fernández, P. and Ceacero-Moreno, M. 2021. Study of the training of environmentalists through gamification as a university course. Sustainability, 13(4), 2323.

11. Climate Change Education. (https://climatechange.tw/); Ministry of Education. (https://english.moe.gov.tw/mp-1.html).

12. Jhih Shan High School. (https://www.lovejs.tw/home); National Taiwan University. (https://www.ntu.edu.tw/); National Taiwan University Graduate Institute of Building and Planning. (http://www.bp.ntu.edu.tw/).

Platform and discuss how gamified SDG 13 climate action projects can raise the climate awareness of citizens across generations. Our research thus bridges the gap between policy and action, by approaching climate action from the perspective of rural youth and their needs.

## SECTION I: PLATFORM

Even though Taiwan is not a member of the UNFCCC, the Kyoto Protocol or the Paris Agreement, these have all influenced the Taiwanese government in its response to the international consensus. The Executive Yuan passed the National Climate Change Action Guidelines in 2012, and the National Development Council coordinates with cabinet ministries to formulate climate-safe policies. These are the ministries for science and technology, transportation, economics, interior affairs, health and welfare, and agriculture. Municipal governments, county authorities, and local communities also participate in the implementation of these policies. The MOE is responsible for promoting environmental education, cultivating transdisciplinary professionals to respond to climate change issues, informing the public about these issues, and encouraging citizens to adopt low-carbon habits.

Since 2012, the MOE has been promoting the "Climate Change Adaptation Cultivating Talents Technology Programme" (CCAC Talent Programme). Within MOE, the Department of Information and Technology Education (DITE-MOE) has coordinated the CCAC Talent Programme. Since 2013, the MOE has restructured its departments to sustain climate-oriented programmes. DITE-MOE, highlighted in purple in Figure 1, is responsible for developing teachers' networks and online and offline platforms to coordinate climatological educational resources. Combining with the Computer Centre, the Advisory Office, and the Division of Environmental Protection Education, the DITE-MOE is a new technological office responsible for informational and education policymaking and management. It also plans, promotes, monitors, and assesses prospective, professional, and cross-professional education programmes for technology, humanities, and social sciences. More importantly, DITE-MOE plans and promotes policies about environmental education in schools, plans and realises sustainable development, and cultivates talent and inter-departmental collaboration. It implements disaster prevention education in schools and safety management in research laboratories; it also plans and promotes policies on chemical and waste management.

After introducing the climate action duty of DITE-MOE, we introduce the CCAC Talent Programme in Figure 1. This programme provides colleges and universities grants to offer general education courses on sustainable development and

climate change adaptation. It offers college students opportunities to learn about sustainable development and climate change, and provides funds to colleges' and universities' interdisciplinary credit programmes that help cultivate adaptation to domestic climate change. In 2015, the Programme completed the integration of professional teaching materials in eight areas of climate change adaptation. In 2016, the Programme established the Climate Change Adaptation Teaching Alliances (CCAT Alliances) to assist in implementing climate change adaptation in professional fields.

**Figure 1: The Department of Information and Technology Education (DITE-MOE), marked in purple, serves as the office to coordinate SDG 13 Climate Action-related educational programmes and policies. The comprehensive systems of the educational climate action transformations include all levels of schools nationwide. The structure is the ecosystem that supports the CCE Platform. (Translated from Chinese to English by the authors.)[13]**
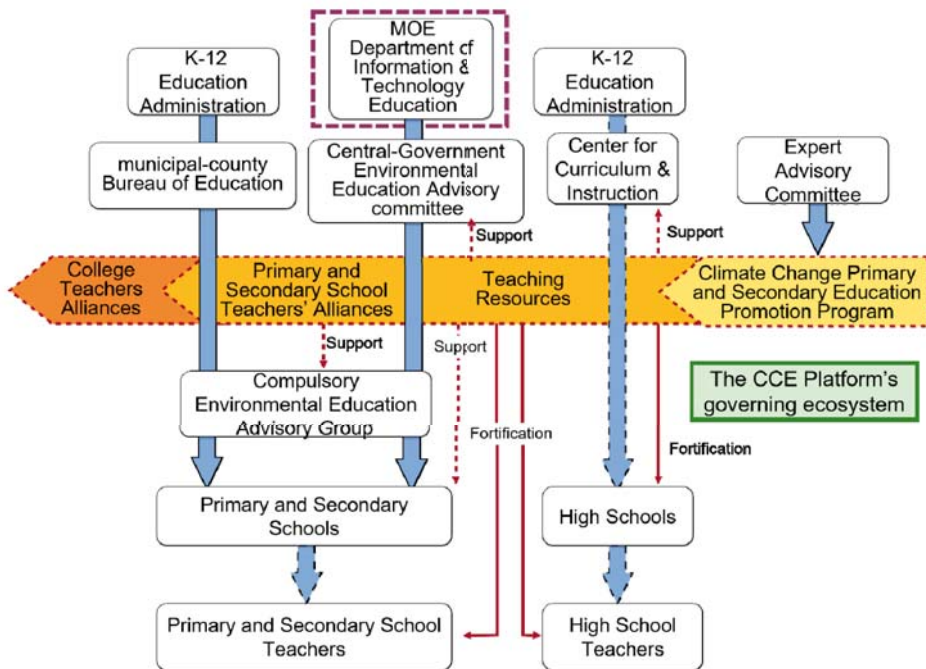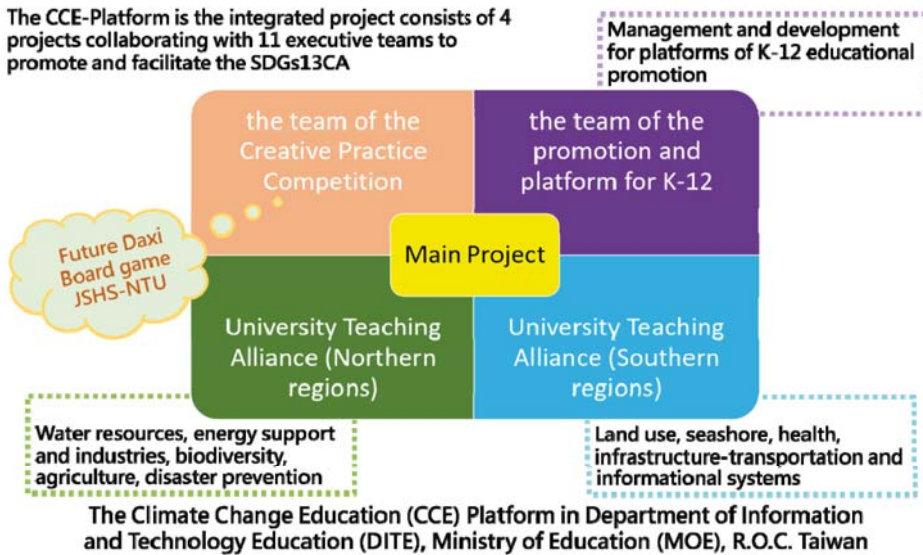


By doing so, the DITE-MOE is responsible for establishing Climate Change Education in Taiwan (henceforth, the CCE Platform) (Figure 2). Educational and

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13. Chiou, C.-R. 2019. 育部氣候變遷人才培育成果 [Ministry of Education's Climate Change Talent Development Results]. Taipei, Taiwan: 育部資科司 [The Department of Information and Technology Education (DITE-MOE)].

school-based SDG 13 Climate Action activities are critical in rallying civic engagement against a climate crisis. Thousands of teachers and students from K-12 to higher education have applied for grants through the CCE Platform since 2015.

**Figure 2: The functions and coordination of the CCE Platform in Department of Information and DITE, MOE, R.O.C. Taiwan. (Translated from Chinese to English by the authors.)[14]**



The CCE-Platform is the integrated project consists of 4 projects collaborating with 11 executive teams to promote and facilitate the SDGs13CA

Management and development for platforms of K-12 educational promotion

the team of the Creative Practice Competition

the team of the promotion and platform for K-12

Future Daxi Board game JSHS-NTU

Main Project

University Teaching Alliance (Northern regions)

University Teaching Alliance (Southern regions)

Water resources, energy support and industries, biodiversity, agriculture, disaster prevention

Land use, seashore, health, infrastructure-transportation and informational systems

The Climate Change Education (CCE) Platform in Department of Information and Technology Education (DITE), Ministry of Education (MOE), R.O.C. Taiwan

The CCAE Platform evolved from the CCAC Talent Programme. Figure 3 shows that the teachers' alliances first appeared in the CCAC Talent Programme in 2012. In addition to teacher training, the CCE Platform offers a database containing hundreds of climatological teaching modules, including PowerPoint slides, videos, and syllabi.

14. Climate Change Education. (https://climatechange.tw/Home/Page/8).

**Figure 3: The Climate Change Education Platform of Taiwan. (Translated from Chinese to English by the authors.)[15]**
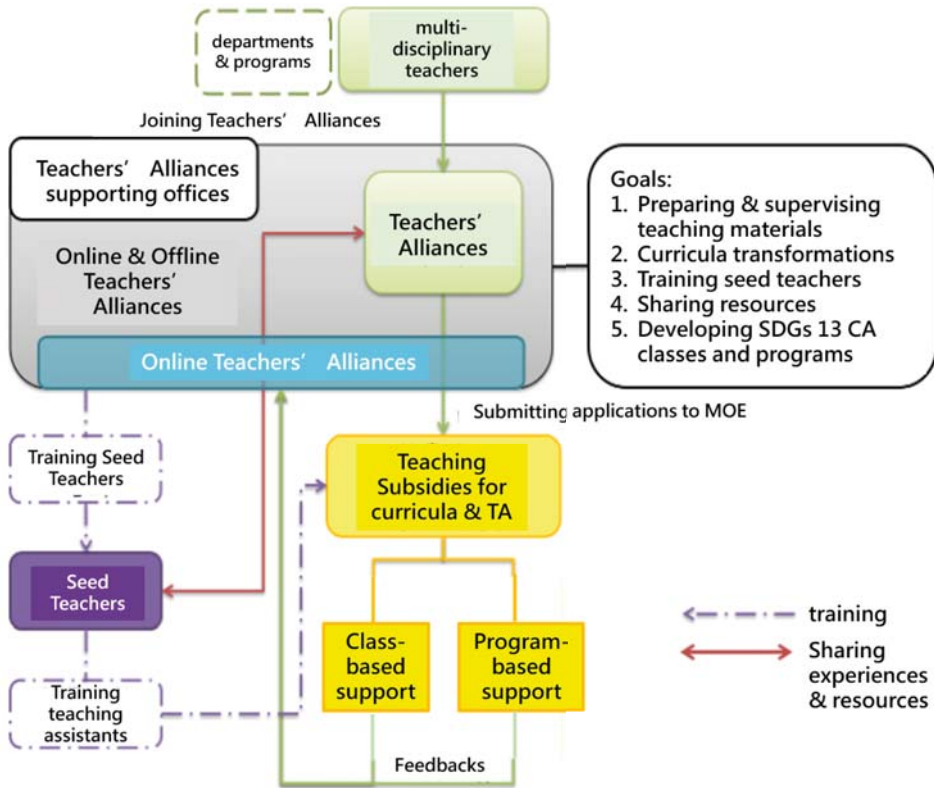


By 2018, the CCE Platform integrated MOE, K-12 schools, and all colleges and universities. Figure 3 depicts the supporting ecosystem of SDG 13 Climate Action.

## SECTION II. THE CONTEST AND THE TEAM

We focus here on the Climate Change Adaptation Creative Practice Contest (CCACP Contest). To win, student contestants must show their understanding of climate change adaptation and their ability to propose problem-solving strategies. Students collaborate with university students of different majors; select issues and problems; survey the conditions; decide on target audiences; and negotiate solutions and strategies. From 2016 to 2021, thousands of students and hundreds of teachers on 519 teams participated in the contest (Table 1). A team can have no more than

15. Climate Change Education. (https://climatechange.tw/Home/Page/11?pageId=10).

three members. Sixty teams have won awards in the CCACP Contest. Twelve of the winning teams have gamified their climate-related strategies.

**Table 1: Gamified Winning Projects of the Climate Change Adaptation Creative Practice Contest. (Data compiled by the authors.)[16]**

| Year | Total Teams | Winning teams # | Gamified Winning Project Name | Team School | Ranking |
|------|-------------|-----------------|-------------------------------|-------------|---------|
| 2016 | 41 | 6 (3+3) | Golden Blue Ark | NTNU-GISE | 1ST Prize |
| 2017 | 38 | 6 (3+3) | The Pressure of Temperature | NTNU-GISE | 1ST Prize |
| 2018 | 150 | 6 (3+3) | SAVIOURS | NTNU-GISE | 1ST Prize |
| | | | My Mileage of Green | NTNU-DG | 2nd Prize |
| | | | Go with Climate change | NCKU-DUP | 3rd Prize |
| 2019 | 92 | 10 (5+5) | Disaster reduction together | MCU-DUPDM | 3rd Prize |
| | | | De Waterwolf: A Crossgenerational Game of Flooding Resilience | NTU-DG | Best Work (BW) Award |
| 2020 | 109 | 11 (5+5+1) | Future Daxi Board Game | NTU-GIBP | 3rd Prize |
| Covid-19 starts | | | (introducing Future Daxi in following sections) | | |
| | | | Shennong's Time Machine | NTNU-DG | BW Award |
| 2021 | 89 | 11 (5+5+1) | Green ProTech | NCCU-DLE; NCCU-DKLC; NTOU-DSTM | BW Award |
| | | | Critical Point | NTUST-GIDLE | BW Award |
| | | | Zoumei | NPUST-DAS | BW Award |
| Total | 519 | 60 | 12 【7 ( 3X1st +1X2nd+3X3rd) + 5BWAward】 | 11 universities | |

Most studies of climate action gamification focus on how environmental games stimulate game players' environmental values and change their behaviour (Ahamer 2013, Ouariachi et al. 2020, Reckien and Eisenack 2013)[17]. Our case study empha-sises the design process and the way in which adolescent designers integrate local knowledge, stimulate community engagement and transform the identity of their hometown landscapes. Members of the participating teams collaborate on compe-tition projects, some of which take years to develop. We concentrate on the Future Daxi board game, winner of the bronze medal in 2020. We discuss how the game design influences adolescents' understanding of their hometown environments and their life paths. How have NTU graduate students and JSHS adolescents devel-oped their partnership to translate Daxi local knowledge into game design?
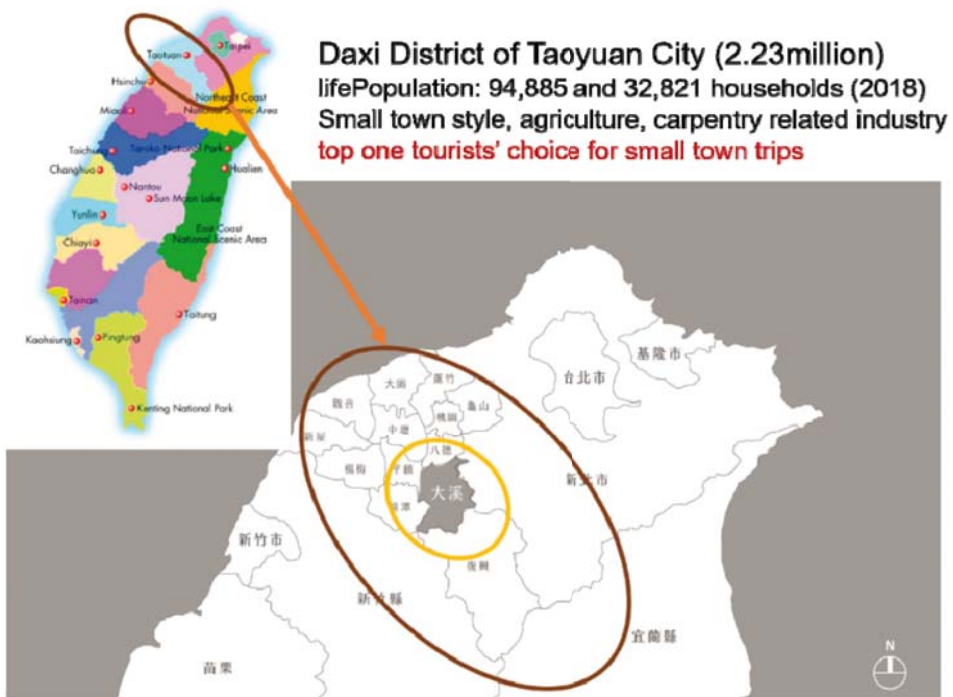
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16. Climate Change Education. (https://climatechange.tw/Creative/SummaryOfResult).

17. Ahamer, G. 2013. Game, not fight: change climate change! Simulation & Gaming, 44(2-3), 272-301; Ouariachi, T., Li, C.-Y., and Elving, W. J. 2020. Gamification approaches for education and engagement on pro-environmental behaviors: Searching for best practices. Sustainability, 12(11), 4565; Reckien, D. and Eisenack, K. 2013. Climate change gaming on board and screen: A review. Simulation & Gaming, 44(2-3), 253-271.

In the 2016 contest, Li (the fourth author) received his master's degree in sociology from National Tsing Hua University and became director of the Agricultural Marketing Programme at the JSHS in his hometown of Daxi. Most of his students attended JHSH. Li soon realised that his students paid little attention to the classroom readings. Therefore, he collaborated with the NTU team (the other authors of the paper) to develop field-learning oriented projects that incorporate Daxi local knowledge. In the NTU-JSHS partnership, NTU students tutored JSHS students, while the JSHS students helped the NTU students understand Daxi's environment and culture. Daxi's old town ranked as one of the top travel destinations for domestic travellers in Taiwan. (Figure 4 gives background information about the community.) Vocational high schools are essential for the education of Taiwan's rural youth. According to the 2018 High School Graduates Employment Survey (MOE 2018), of 231,000 senior high school graduates, only 42.7 per cent were from general senior high schools. More than half (57.3 per cent) were from non-general senior high schools.

**Figure 4: Map and background information of Daxi.[18]**



Daxi District of Taoyuan City (2.23million)
lifePopulation: 94,885 and 32,821 households (2018)
Small town style, agriculture, carpentry related industry
top one tourists' choice for small town trips

18. Map prepared by the authors.

The NTU-JSHS team experimented with ways to improve learning motivation and to raise the college-entering rate of rural youth and determined that the two fundamental mechanisms were cross-generation peer mentoring (Karcher 2014, Sundli 2007)[19] and gamification of local knowledge (Huang and Chang 2017, Chang and Chen 2020)[20]. Young people in Daxi are very involved in designing and playing board games. In 2018, JSHS teenagers initiated the designing of a climate change board game for K-12 students and Daxi tourists. "We want visitors to come to Daxi, not to consume our hometown. They shall, more or less, understand Daxi before the trip," said the JSHS students. The game design process began in 2018 and ended in 2021. NTU and JSHS members all appreciated learning from each other. The experiment began with JSHS members complaining that merely reading books in classrooms bored them, and proposed learning from playing. They suggested a climate-related board game introducing Daxi to outsiders. Their experiences with climate change were personal, based on their farming families' unhappiness when the weather was bad. While the NTU graduate students were amazed by the reaction of JSHS farmers' experience with climate change, the NTU members supported the idea of a game about climate change and took the initiative in its design. In 2018 and 2019, the first author offered classes on game development at NTU. The high school students enrolled in the classes. Even though they were exhausted by the 10-hour round trip, they were inspired by their NTU peer mentors to create the rules and strategies for the game, which they named Future Daxi.

Future Daxi combines the story of Noah's Ark (Genesis 6-9) and the Kabocha tree from a Daxi folktale. According to the JSHS students, the beloved tree is 50 years old. When an urban development project wanted to cut the tree down, community leaders and residents joined together to protect it. The NTU-JSHS team uses the story as the metaphor for Daxi's SDG 13 Climate Action game. The game is set in 2050, and the beloved Kabocha tree is withering. The Meteorological Bureau forecasts that the dying of the tree could cause heavy rains and the rising of the Dahan River to flood Daxi old town. To save the town, six players must deliver 20 buckets of water to irrigate the withering Kabocha tree. The six roles are Tribal Senior, the

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19. Karcher, M. J. 2014. Cross-age peer mentoring. In M. J. K. David L. DuBois (ed.), Handbook of youth mentoring (Vol. 2, pp. 233-257). Thousand Oaks, CA: SAGE Publications, Inc; Sundli, L. 2007. Mentoring—A new mantra for education? Teaching and teacher education, 23(2), 201-214.

20. Huang, H. and Chang, S. E. 2017. Place-based Learning and Change of Sense of Place: Educational program in a historic town. Environment-Behavior Proceedings Journal, 2(6), 363; Chang, S. E. and Chen, Y.-Y. (2020). Knowledge ties in the emerging of place-based pedagogies. Journal of Design, 25(4), 43-64.

naughty Teenager, the Uber-water Guy, the YouTuber, the High-tech Farmer, and the Wood artist (Figure 5). The JSHS students identified with the naughty teenagers; the NTU students wanted to be YouTubers.

**Figure 5: The six roles generated from the Daxi community by the JSHS-NTU team.[21]**



By 2020, the NTU-JSHS had completed the prototype of the Future Daxi game, and three NTU students represented the team to submit their board game. Unfortunately, that was when COVID-19 broke out in Taiwan. Most of the preparations and presentations moved online because team members were in Taipei, Tokyo, and Hangzhou. Even though JSHS and NTU members could not conduct on-site discussions, the Future Daxi board game received the third prize in the 2020 CCACP Contest. The NTU and JSHS members were proud of their accomplishment.

## SECTION III. GAME DESIGN AND REFLECTIONS

The choice of the board game design and theme were collective decisions. As a result, the game integrates the local and global and translates knowledge acquired from local interactions and global climate change knowledge into the game. The game was constructed through a parallel mechanism of goals, rules, and feedback. The translation is key to the gamification of local knowledge. For example, local places were given special significance because they are part of the residents' consciousness. In the Daxi interviews, participants agreed that Daxi Old Street had the most significance. It was where players could eat as much as they liked. Exploring and translating local knowledge gave designers and players an understanding of the rural (Xie 2021)[22].

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21. Images prepared by the authors.

22. Xie, Z. 2021. The Construction and Identification of Gamifying Local Knowledge in Youth Empowerment—a Case Study of Co-creating the Community Board Game of "Daxi 2050" to Confront Climate Change. National Taiwan University.

The components of the Future Daxi board game include: the 25 pieces of squares representing the land of the Daxi community, the scale of the water metre for watering the sacred tree, the Ancient Cards, and three types of Fate Cards and dices (Figure 6). The scale of the water metre represents the number of buckets of water that players must bring to the tree. Players may confront extreme weather events or discover supportive resources. Their success in saving the community is not guaranteed. We tested the game with International Degree Programme of Climate Change and Sustainable Development (IPCS) faculty and students in the climate change programme at NTU. The IPCS director remarked:

> Even though we failed twice, the game is enjoyable and follows sustainable development principles. The best way to complete the mission is to keep most land pieces unopened and concentrate on watering the tree together. We calculated too much about the pros and cons of each land square we opened. IPCS students concentrated on watering the tree. They completed the game soon.

**Figure 6: Future Daxi Board Game Design.[23]**

23. The Sustainable Development Goals (SDGs) logo. (https://www.un.org/sustainabledevelopment/news/communications-material/). Images prepared by the authors.

# The Ancient Cards

Six Daxi gods and sages, familiar to the Daxi people, are depicted on the Ancient Cards (Figures 7 and 8). The game designers have given the gods and sages magical powers associated with climate action.

**Figure 7: Local gods with magical powers.[24]**



**Figure 8: Historical sages as rescuers.[25]**

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24. Images prepared by the authors.
25. Images prepared by the authors.

## Fate Cards

The Fate Cards depict the climate disasters in the Daxi region. Among the natural disasters are acid rain, mudslides, dust storms and typhoons. Human-made disasters such as industrial spills and greenhouse gas emissions will affect the game environment differently.

## Yellow Fate Cards

Acid Rain, Cold Stream, and Drought are frequent but less severe climate disasters.

**Figure 9: Yellow Fate Cards.[26]**
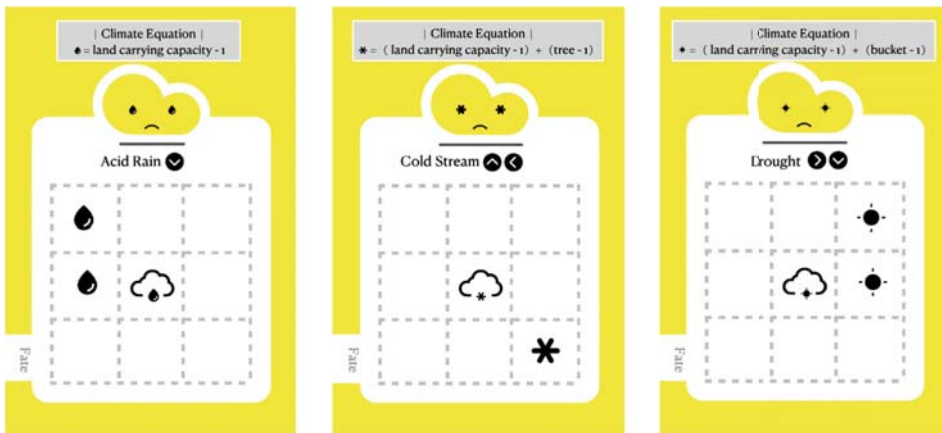


Acid Rain: The design team decided on acid rain first. Taoyuan has experienced the most damage from acid rain in Taiwan.

Cold Stream: A card developed for the team's follow-up discussion. The frequency of cold streams hitting the local weather station has increased. At the end of January 2020, the first wave of cold spell hit Taiwan. The lowest temperature recorded in Taiwan was 5.1 degrees at Daxi in Taoyuan, and this had a significant impact on crops.

Drought: The design team intensively discussed the drought in Daxi. Lack of rainfall and persistent high temperatures have caused a drought and a water shortage. In early 2021, a drought struck western Taiwan (including Taoyuan Daxi), causing water restrictions, farming suspension, and business shutdown.

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26. Images prepared by the authors.

## Orange Fate Cards

Orange Fate Cards (Figure 10) represent more serious problems than Yellow Fate Cards: Meteorological Explosion, Global Warming, Wild Boars, Heavy Rain Report, and Industrial Wastewater.

**Figure 10: Orange Fate Cards.[27]**



Meteorological Explosion: Weather forecasting is the use of current changes in atmospheric conditions to derive future weather conditions through fluid mechanics.

Global Warming: Greenhouse gas emissions cause temperatures to rise. The surface temperature in Taiwan has increased by 1.3 degrees in the past 100 years and is increasing even faster this year.

Wild Boars: Wild boars often eat crops. In places with hunting restrictions or bans, these animals occupy farmland and threaten crops meant for people.

Heavy Rainfall Report: Daxi's summers always see heavy rains. Last summer, on 13 July 2021, it rained for two hours, with an hourly rainfall of 73mm. The rainwater accumulated to 50cm deep and damaged farmland and roads.

Industrial Wastewater: The discharge of industrial wastewater is an entirely human factor, and its impact can be controlled locally. Wastewater has a significant impact on soil, crops, organisms, and climate.

27. Images prepared by the authors.

## Red Fate Cards

There are only three Red Fate Cards (Figure 11): Severe Typhoon, Forest Fire, and Earth Flow.

**Figure 11: Red Fate Cards.[28]**



Severe Typhoon: Typhoons are one of the most destructive natural disasters and the greatest climate threat to the people's livelihood and economy in Taiwan. A Severe Typhoon card destroys all the new houses and trees on the board.

Forest Fire: In addition to climate change, the lack of forest management and insufficient firefighting resources are the causes of forest fires. The fire season is getting longer every year, and the weather is getting hotter and drier. A Forest Fire card destroys all of the board's newly planted trees.

Earth Flow: Typhoons and rainstorms, under the conditions of a broken rock layer and a steep slope, will quickly cause soil to loosen and cause movement of earth and rock. Historically, typhoons have caused major landslides in the Daxi-Shimen Water Protection Zone, resulting in significant losses of life and property. An Earth Flow card damages all new houses on the board and results in their removal.

28. Images prepared by the authors.

## REFLECTIONS

From 2019 to 2020, we managed dozens of game trials with hundreds of players, including high school and college students, university professors, and residents of different communities. We also ran online and offline trials in China and Japan. We organised players' reactions based on the second author's field notes. Some players were excited by the challenges; others were more strategic and careful. Some players responded immediately to unexpected situations; others tended to observe before acting.

The board game reflects different ideas of collaboration on climate action. While testing the game in the "Game of Life" class at NTU, students shared their feelings:

> At first, I think that the rules of this board game are very complicated, but soon you enter the game situation, and you feel that the game design is very fine; there are many wonderful details that you can feel the dynamic relationship between the players' actions and the climate action related crisis. I also feel that local cultural factors and climate action strategies are well combined through the game. (Student 1)

> The most meaningful game experiences for me included the discussion and support among the different characters, and working together for the goal of saving the sacred tree. This game stirred up my memories of Daxi and my awareness of climate change. (Student 2)

The game design workshop was held in 2019. The Daxi historical district became a field-based learning landscape for JSHS students. In 2020, in the game design stage, the JSHS students provided ideas and local knowledge. The NTU students incorporated that knowledge into the game design. The game won a national award, a significant learning experience for the JSHS students. They have been encouraged to make similar improvements in their learning, career pursuit, and rural understanding. More importantly, they passed their college entrance examinations and enrolled in college in 2022. Only two members withdrew at the end of their first year. There are still many barriers to overcome to transform learning models dominated by books and examinations.

## CONCLUSION

Climate-related risks threaten both urban and rural areas around the world. Greta Thunberg's Youth4Climate stimulated Fridays for Future. The younger generation has taken the initiative in climate action. From educational climate action policy installations in Taiwan to adolescents' Future Daxi board game designing, our research links the state's political strategies to the actions of the youth. The board game allows young people to learn about climate disasters through relatively playful ways. Designing a climate-action game provides interactive processes to manipulate and to strategise players' fate in the unpredictable weather conditions. Through gamification, young people can form unique connections to their daily landscapes, reframe their community's sustainable culture, and reflect on ways to make their community resilient to disasters.

Since we met in 2018, the young members of the JSHS-NTU team in our research have continued their life paths. Some of them were high school students; others were graduate students. In the autumn of 2022, all high school students in the team entered college because of the stimulation of the Future Daxi game design project. They realised that higher education could help them to contribute to their hometown. In the meantime, the NTU team members all received their Master's degree and became community planners. Three core members carry on Daxi's rural educational projects. They have formed a team to revitalise Daxi through gamification. The Future Daxi board game is now in its third iteration and is ready for marketing. Its target audience is K-12 students. The JSHS-NTU members propose to test the game in Daxi's elementary and high schools.

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