Article

Examining the Use of Serious Games for Enhancing Community Resilience to Climate Risks in Thailand

Wijitbusaba Marome [1,*] , **Boonanan Natakun** [1] **and Diane Archer** [2]

1 Faculty of Architecture and Planning, Thammasat University and Thammasat University Research Unit in Urban Futures and Policy, Pathum Thani 12120, Thailand; boonanan@ap.tu.ac.th
2 Stockholm Environment Institute, Bangkok 10330, Thailand; diane.archer@sei.org
* Correspondence: wijitbusaba@ap.tu.ac.th

Abstract: This paper presents the 'Kin Dee You Dee' (Thai for 'Eat well, live well') toolkit, which comprises three sets of serious games aimed at facilitating discussions and transformative learning on resilience to urban low-income communities. The first stage of the toolkit creates awareness of key concepts related to resilience, the second stage allows participants to map individual and community assets and identify risks associated with them, and the final stage encourages participants to reflect upon potential threats and to create a strategic plan in response. The study examines the toolkit's potential in increasing meaningful community engagement and participation, and enhancing disaster risk awareness through the application of the toolkit in the Bangkok Metropolitan Region and Udon Thani province, which are areas that are highly exposed to climate risks. This paper presents the concepts, development and application of the 'Kin Dee You Dee' toolkit, concluding that it is a useful tool that can allow policymakers and other involved stakeholders in city development projects to engage with communities and increase risk awareness.

Keywords: serious games; community resilience; climate risk resilience; participatory planning; risk awareness; Thailand

1. Introduction

While games and playing have been present throughout human history, the nature and use of games have been changing rapidly in the past decades as a result of technological advancement and rapid social changes. The concept of *serious games* has emerged in the past few decades, and attempts to explore the potential of games not only as a form of entertainment but also as a useful tool for purposes such as communication and pedagogy [1]. Serious games seek to strike a balance between learning and fun [2] and can be considered a powerful and persuasive tool in nature, encouraging engagement and participation [3] as well as facilitating ideation and stimulating discourse and experiences around key issues [4–7]. Therefore, they intentionally produce a pedagogical shift from passive to active [2] (p. 133) The use of serious games in fields of architecture, urban design and planning has increasingly under spotlight because they help encourage participatory design and planning activities supporting speculations of their living environment and conditions for future development [8–11]; This paper presents the conceptual framework and development of and findings from using the "Kin Dee You Dee" (Thai for "Eat well, live well") toolkit, which is a set of serious games that have been developed to enhance community engagement and learning about climate risk resilience in Thailand. This paper is particularly interested in examining how serious games can help address two specific challenges of achieving disaster risk resilience: how to increase meaningful community engagement and participation, and how to effectively enhance disaster risk awareness. Overcoming these two challenges could help low-income communities become more informed and therefore more prepared and capable of adapting to risks, as well as becoming more likely to utilize collective actions and of community resources to achieve resilience,

thereby allowing them to be less reliant on external forces and actors for disaster relief. The use of games among lower-income population groups can facilitate community-based adaptation (CBA) and thereby address social, economic and political drivers of vulnerability. Therefore, participatory gaming approaches present an opportunity to inform and empower local communities and therefore enable not only community-based adaptation but also transformative adaptation which challenges current, exclusionary and inequitable, development trajectories [12].

The development of the 'Kin Dee You Dee' toolkit was initially focused on low-income communities in the Bangkok Metropolitan Region (BMR). The toolkit's iterative testing was also carried out with participants from three low-income communities in the BMR between 2018 and 2019. However, the toolkit is transferable. This paper will also discuss the use of the toolkit in a different context—Udon Thani, a province in northeastern Thailand. Despite the two region's differences, there is an immediate need for consolidating urban risk resilience in the BMR and in Udon Thani, especially among their vulnerable populations, because both study areas face climate-related risks while experiencing urban growth. The study found that to an immediate extent, the toolkit was effective in encouraging deliberation and in raising awareness about climate risks for its players, though additional research needs to be conducted to understand its potential long-term impact.

2. Conceptual Framework

2.1. Community Resilience

The main purpose of the 'Kin Dee You Dee' toolkit is to enhance community resilience through social learning and capacity building. The game also aims to foster values of preparedness of crises and individual and collective assets. Resilience can be generally understood as "the capacity of systems to reorganize and recover from change and disturbance without changing to other states" [13] (p. 341). The UN Office for Disaster Risk Reduction offers a comprehensive definition of resilience as "the ability of a system, community or society exposed to hazards to resist, absorb, accommodate, adapt to, transform and recover from the effects of a hazard in a timely and efficient manner, including through the preservation and restoration of its essential basic structures and functions through risk management" [14]. Community resilience can therefore be defined as the "existence, development and engagement of community resources by community members to thrive in an environment characterized by change, uncertainty, unpredictability and surprise" [15] (p. 401). A highly resilient community is one that is able to quickly recover from stresses and shocks through collective and strategic actions. The resilience of a community is complex and is influenced by a myriad of factors including the resilience of its individual members and of households, as well as the community's resources and assets, including intangible assets such as social capital. Agrawal and Gibson [16] highlight how social or power structures within a community should also be taken into account when analyzing their resilience because a community comprises intra-community groups with different interests and allegiances. The resilience of a community is also related to its ability to innovate and adapt, which are crucial for sustainable development [17].

2.2. Using Serious Games for Participatory Planning and Community Engagement for Enhancing Disaster Risk Resilience

The term 'serious game' was coined by Abt [18] and is now generally used to refer to a game that is designed to serve a purpose beyond the amusement or enjoyment of its players. Serious games can have a pedagogical or persuasive purpose and have been used in various fields including but not limited to education, healthcare, water management and urban planning [19–24]. Serious games enable interactive storytelling and allow players to participate in a simulation where they may be faced with circumstances that require them to think critically and analyze issues from a new perspective, and to reconsider the roles they may take in the face of different situations [25,26]. However, it should be noted that there is still limited empirical evidence on the effectiveness of serious games and game-based

learning in the domain of environmental management, as a result of limited systematic evaluation for the games [27]. Through a quantitative literature review of publication on 60 persuasive games, Soekarjo and Van Oostendorp [28] found that out of the 15 selected papers reviewed, only six measured the outcome in attitude change, nine measured the outcome in knowledge change and four measured behavioral change.

In recent years, serious games have been utilized in areas relating to sustainable development [29–31] There are therefore multiple analyses on the subject that have influenced the development of the 'Kin dee You dee' toolkit. Ouriachi et al. [32] explore different serious games in the field of sustainability and summarize their objectives as "(a) making players aware of the challenges associated with sustainability, (b) providing knowledge and understanding with the issue of sustainability, and (c) encouraging players to take actions and develop solutions that are environmental and socioeconomic balanced". More specifically, Solinska-Nowak et al., [33] analyzes serious games for disaster risk management (DRM), concluding that

> "The most successful serious games use real objects, symbolic tokens, rules, instructions, sets etc. to enable players to learn through processes or problem-solving (often referred to as procedural or simulation rhetoric) rather than through simply answering quiz questions and memorizations of facts [...] Secondly, as the study revealed that the majority of DRM-related serious games and simulations constitute an engaging multiplayer experience, it seems reasonable to assume that they may trigger strong emotional reactions, provoke conflicts and misunderstandings. Therefore, a qualified facilitator or detailed facilitation instructions should be provided to avoid the risk of players experiencing negative feelings that are not properly addressed" (p. 1026).

Serious games are also useful as a tool for participatory planning, which can be understood as urban planning processes that involve members of the affected community in a meaningful way [3,34]. In their study regarding a framework for participatory planning in the context of risk, Rizzi and Porebska [35] (p. 1) note that "urban gaming simulation is not an urban game. It is a tool adaptable to all goals, be they too big or too small, as it allows the discovery of new scales, new optics, and different points of view". As such, serious games are a useful tool for encouraging and facilitating deliberation, which is a process that is central to participatory planning [36]. It is especially important to encourage participatory planning processes in low-income communities, who often face marginalization, because it could help them before more capable of mobilizing as a community to influence development decisions that affect them. In the context of risk resilience, participatory planning could enable plans that are better-suited for the specific demands and resources of each low-income community.

3. Materials and Methods: Developing the 'Kin Dee You Dee' Toolkit

3.1. Background

The 'Kin Dee You Dee' toolkit was developed as part of the 'Planning for Eco-Cities and Climate-Resilient Environments: Building Capacity for Inclusive Planning in the Bangkok Metropolitan Region (PEACE-BMR)' research project [37]. PEACE-BMR examined the following questions: (1) What are existing adaptive mechanisms of households for crises? (2) Do communities have collective resilience strategies and what role do community assets play? and (3) What are the implications of multi-level governance towards urban resilience. The 'Kin Dee You Dee' toolkit was designed as a pedagogical tool for enhancing community-based adaptation and to respond to challenges to community resilience that were identified by the research of PEACE-BMR. The toolkit is therefore made to be participative and designed to be used mainly by players who come from the same community.

The 'Kin Dee You Dee' toolkit was developed through a collaboration between the PEACE-BMR research team and the community architect collective OpenSpace, who was previously involved in the creation of a board game on urban flood risk resilience in the BMR as part of the Coastal Cities at Risk research project. This past experience affirms

that such games "could be used as an effective deliberative tool for knowledge exchange, transformative learning and gathering inputs for policymaking" [38] (p. 1), as well as for disseminating research findings in an interactive way. The format of a board game was chosen so that the toolkit would be easy to transport and usable in places where there is no access to electricity or internet connectivity.

The purpose of the 'Kin Dee You Dee' toolkit is to help participants learn more about concepts relating to community assets and resources in relation to risk resilience, to facilitate discussion about community resilience, and to produce a community resilience strategy as an output. The 'Kin Dee You Dee' toolkit comprises three games, which are designed to progressively introduce players to key concepts before encouraging them to make connections between these technical terms and their own community. In general, serious games are designed to have basic elements and sub-elements, not only to be structured but also to persuade players at different levels [39]. Having various levels of game design where one level leads on to the next, players can advance to understand complexity and thus are able to make future decisions [3] (p. 4). Serious games used in development contexts can offer a safe environment by creating realistic 'simulations' where long-term impacts, plans and policies can be perceived and tested [40]. The second game in the 'Kin Dee You Dee' toolkit presents the players with scenarios that they have to collectively react to, such as various natural disasters, in order to help convey the complexity of such scenarios that bring to light social, economic, and environmental problems that the community may face. The last game in the toolkit asks the players to come up with coping strategies, which highlights how there are multiple possible solutions. The game therefore presents a simulation of risks that the players' community may face, thus allowing them to experiment with potential solutions and fostering their ability to respond to such challenges [41], thereby enhancing the community's capacity for transformative adaptation.

The 'Kin Dee You Dee' toolkit is both a pedagogical tool and a visual guide for facilitating community dialogue on urban risk resilience. Given the target audience of members of low-income communities and not policy experts, the toolkit was designed to be engaging and easy to understand. Extra attention was given to making sure that technical terms are introduced in a way that would allow all players to understand them. The majority of the feedback received from players during the game testing and development phase were related to ease of understanding and the visual aspects of the game. Through multiple design iterations based on participant feedback, the toolkit became highly visual, relying on images and pictograms instead of text whenever possible. Attention was also given to the need to ensure that the toolkit will be able to deliver the essential information and fulfil its goals without requiring too much time. The toolkit was also designed to be replayed whenever possible. Therefore, an incremental learning through a transformative game design would help players to repeat their decisions when facing similar situations, thereby transforming the player's 'real' actions as they progress through similar scenarios [3]. Following the conclusion of the PEACE-BMR research project, the 'Kin Dee You Dee' toolkit will be used by the Community Organisation Development Institute (CODI), a state agency supporting community-driven development in Thailand, in order to engage with informal communities in Thailand and enhance their climate risk resilience (see Figure 1).
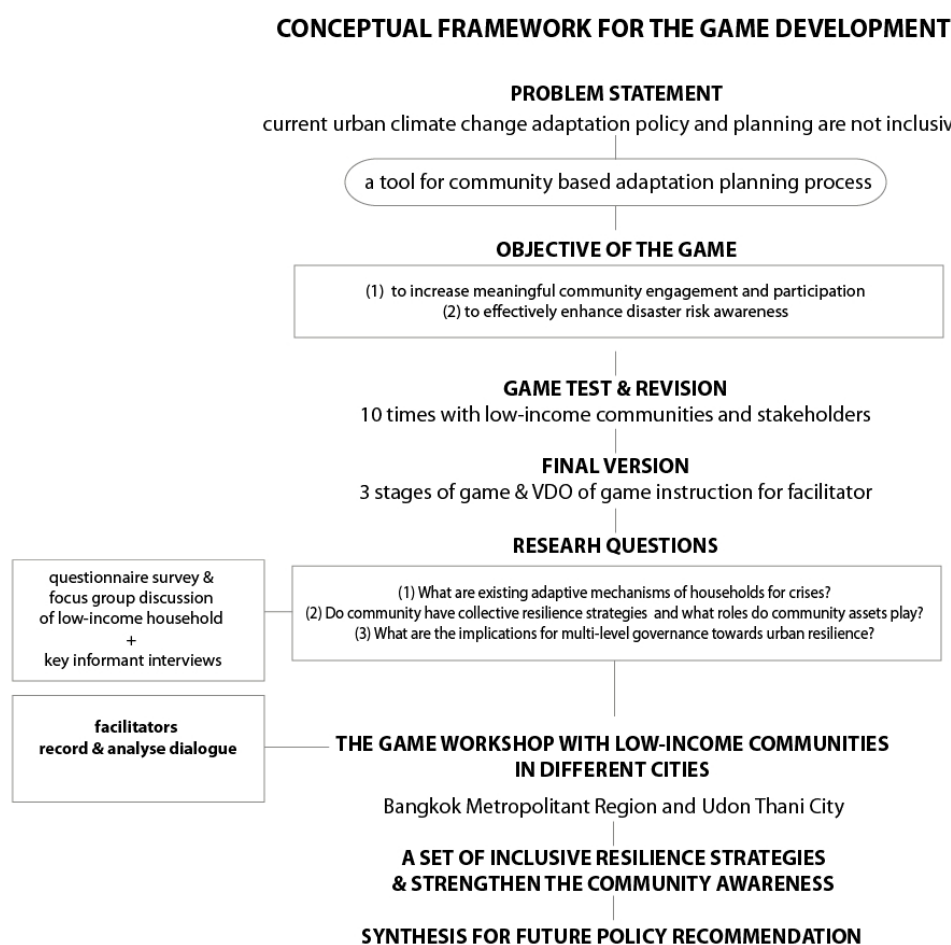
CONCEPTUAL FRAMEWORK FOR THE GAME DEVELOPMENT

PROBLEM STATEMENT
current urban climate change adaptation policy and planning are not inclusive

a tool for community based adaptation planning process

OBJECTIVE OF THE GAME
(1) to increase meaningful community engagement and participation
(2) to effectively enhance disaster risk awareness

GAME TEST & REVISION
10 times with low-income communities and stakeholders

FINAL VERSION
3 stages of game & VDO of game instruction for facilitator

RESEARH QUESTIONS

questionnaire survey &
focus group discussion
of low-income household
+
key informant interviews

(1) What are existing adaptive mechanisms of households for crises?
(2) Do community have collective resilience strategies and what roles do community assets play?
(3) What are the implications for multi-level governance towards urban resilience?

facilitators
record & analyse dialogue

**THE GAME WORKSHOP WITH LOW-INCOME COMMUNITIES
IN DIFFERENT CITIES**

Bangkok Metropolitant Region and Udon Thani City

**A SET OF INCLUSIVE RESILIENCE STRATEGIES
& STRENGTHEN THE COMMUNITY AWARENESS**

SYNTHESIS FOR FUTURE POLICY RECOMMENDATION

Figure 1. Diagram showing the process of the 'Kin Dee You Dee' toolkit's development and implementation.

3.2. Description of the Toolkit

The 'Kin Dee You Dee' toolkit consists of three stages of interrelated serious games that are centered around the question of what components and strategies are needed for consolidating community risk resilience. Using a combination of pedagogical activities and simulation, the games work together by stimulating discussions and enabling transformative learning of various communities (see Table 1). The toolkit is to be implemented by trained facilitators, who will lead discussions and ensure that participants will be able to achieve the maximum benefits within a limited time. The toolkit is designed for workshops that are at least 3 hours long, and it can be applied only partially, without the last stage, depending on the purpose of the activity. At the end of every stage, the toolkit asks players to respond to specific questions that will allow them to decompress and reflect upon the activity that they have just completed. For example, after the second stage game, players are asked about which assets do they collectively think are important, and which assets help with their capacity to cope, and which help with their capacity to adapt. These questions also serve the added benefit of allowing facilitators or the game implementor to have an insight into the knowledge, interests and approaches of the community members.

Table 1. An overview of the 'Kin Dee, You Dee' toolkit.

	Stage 1	Stage 2	Stage 3
Objective	Introducing concepts and keywords	Examining assets and risks in the community	Creating a strategic plan in response to possible threats
Sub-objectives	Gaining insight into how participants perceive risks and assets	Encouraging participants to apply the new concepts to real-life contexts	Encouraging participants to consider the different strategies or systematic coping measures for different types of risks, based on the collective assets of the community
Method	Vocabulary matching game	Mapping community assets and imagining risk scenarios	Guided discussions and strategic planning
Outcomes	Participants are more equally familiarized with concepts that are useful for the next stages of the toolkit	Participants gain a deeper understanding about risks and assets, especially in their own community	Participants create an actionable plan that can be a starting point for community action or collaboration with authorities.

The first stage in the toolkit consists of two parts and aims to establish an equal understanding of definitions and concepts to the participants, specifically with regards to resources and assets and how they can be used to enhance community resilience. In the first part of the game, nine types of commonly found resources and assets are introduced. Then, every participant is given five random cards, each representing different assets. In each round, a card showing a category or situation is drawn and placed in the middle. Each player may play their resource card if they are able to justify how the resource is relevant or useful for the specific category or situation. The players earn a point for each resource card played. In the second game of this stage, participants will learn key concepts and terminologies relating to community risk resilience through the challenge of pairing up different words and definitions. Examples of key concepts explored in this activity include 'risk', 'disaster', 'resilience', 'assets', 'resource' and 'climate change'. The correct answers will be revealed after all the vocabulary and definition cards have been paired up, and discussions about the concepts are encouraged (see Figure 2).

The second stage of the toolkit consists of two collaborative activities: mapping assets and exploring threats. The aim of these two activities is to enhance the player's understanding of how their living area could be affected by various situations and risks, and how the different assets can help them adapt to these challenges. Firstly, the participants are given a large satellite map of their community and surroundings. The participants are requested to collectively place reference points (e.g., local landmarks, important facilities, community gateway) on the map. Then, participants are then asked to make a list of different individual and communal assets (see Figure 3). They are also requested to discuss to which these cards refer and where these assets can be found within their community, before placing them onto the map. Finally, the participants are given random events cards, which show crisis events such as flooding, energy deficiency and economic crises. Using an especially designed board as a guide, all participants have to discuss which community assets will be affected and what are the impacts (physical, social, economic) of these events on their lives.

Figure 2. A matching key terminologies and definitions game in the first stage of Kin Din You Dee toolkit.

Figure 3. Placing reference points and community collective assets onto the map in the second stage.

Finally, the third stage encourages players to consider the different strategies or systematic coping measures for different types of risks, based on the collective assets of the community. Using the threats and assets cards from the previous stage, the participants must collectively identify the resources that are at risk and reflect on how these risks could be mitigated. The use of crisis planning diagram is introduced at the beginning of the last stage. Figure 3 shows the circle diagram consisting of three relational rings for planning possible crisis mitigation solutions. At the middle of the diagram, the chosen crisis event card from the previous stage is placed. Then, all participants are requested to discuss what community assets would be affected and at risk. Therefore, they would place their asset cards onto the middle ring. When realizing impacts of possible risks and threats from the crisis on their community assets and lives, participants are then requested to discuss and find possible plans, solutions, and helps to mitigate these impacts. Here, the role of facilitator is important to encourage all participants to contribute and to help guide the discussion in a productive direction. After the strategic plan has been completed, a de-briefing session is held to allow participants to reflect on the issues discussed and to provide feedback on the process of using the toolkit (see Figure 4).

Figure 4. The crisis planning diagram used at the last stage of the toolkit.

The strategic plan made by the community should be shared with the local municipal authorities, possibly with further revisions, or to be used for communicating with government agencies about how the community can become more resilient. This is especially pertinent to when the risks faced by the community can be mitigated only through municipal interventions such as the improvement of canal embankments or infrastructural repairs. The strategic plan produced through the 'Kin Dee You Dee' toolkit may also be a guiding document for community action or a starting point for a more detailed community resilience strategy; many elements of the strategic plan may be implemented by the community themselves, such as promoting waste and greywater recycling, formation of working groups, or providing specific support to particularly vulnerable members of the community.

Finally, an additional benefit of the 'Kin Dee You Dee' toolkit is that it helps researchers, or other external actors such as an NGO, government officer and private sectors, to better understand how different communities perceive risks and how they approach potential solutions for them. The toolkit discussions reveal insights such as the community needs, viewpoints and local knowledge that should be taken into consideration by planners. In fact, the workshops and playtesting of the 'Kin Dee You Dee' toolkit was instrumental in providing qualitative data about the communities for the PEACE-BMR research project, such as insight to how participants perceived climate-related risks or how their communities organize in response to disasters.

3.3. Developing and Using the 'Kin Dee You Dee' Toolkit

3.3.1. The Study Area

The BMR comprises Bangkok and five provinces surrounding the capital and is home to approximately 10.89 million residents [42] (National Statistical Office of Thailand, 2018). It is disproportionately larger than any other urban agglomerations in Thailand in population and in economic productivity. The BMR faces multiple and complex social and environmental challenges that threaten its growth and sustainability. Most notably, the BMR is exposed to flood risks due to its topography and coastal location [43]. Alarmingly, Kulp and Strauss [44] forecast that much of the BMR, including Bangkok, will be partially inundated by 2050 due to sea-level rise. The BMR's flood risks are further exacerbated by land subsidence, the metropolis' urban sprawl, and high levels of social inequality: it is estimated that over 2 million people in the BMR are living in urban slums [45]. In a study of three communities in the same study area, Archer et al., (2019) found that the communities' crisis-response mechanisms "tend to be more at the individual household

level than the collective, community-level, despite the fact that all three communities have a history of collective action through the Baan Mankong initiative (a community-driven housing development program), suggesting that there is scope for planning approaches to build on and sustain social capital as a collective resource."

After the "Kin Dee You Dee" toolkit has been completed, it was also used in Udon Thani, which is a significantly different context from the BMR. With the total population of 130,531 as of 2019, Udon Thani has a growing urban region, but continues to be largely independent on agriculture. It is situated in the northeast of Thailand and its potential for economic growth is influences by its proximity to the Laotian capital Vientiane. The province therefore allows the toolkit to be tested in another sensitive area within a context that differs significantly from that of the BMR. Like many provinces in the North East of Thailand, Udon Thani suffers significant climate risks, most notably in the form of flood and drought [46].

3.3.2. Testing and Using the Toolkit

The development of the 'Kin Dee You Dee' toolkit began in October 2017 and the testing of the toolkit began in January 2018. The design of the toolkit was finalized in January 2019.

Multiple stages of testing were conducted in order to obtain information about the target audiences as well as feedback on how to improve the toolkit and to make it more user-friendly. Pilot tests of the first iteration of the toolkit were held with officers from CODI, who work closely with urban low-income communities, in addition to multiple tests in different communities in the BMR. In each community, community leaders were instrumental in the recruitment of participants and helped gather over 10 participants for each test. Testing for the second version of the toolkit was held with Sirin and Friends, Khlong Sawan, and Sangsan Nakhon Rangsit communities, respectively. In its third iteration, which was tested with participants from Bang Prong District community in Samut Prakan Province, the scope of the toolkit narrowed down to focus on seven types of assets used by community residents and their potential for building resilience: water, food, shelter and people, economic resources, community assets and new resources made from the old (e.g., recycling materials). The fourth version of the Kin Dee You Dee toolkit was tested with participants from CODI who gave positive feedback but nevertheless expressed concerns about the visualization of the toolkit and the time management of the gameplay. The final version of the toolkit was completed in 2019 and was released with an accompanying user manual at the research project's final workshop. The qualitative results of this study were collected from this final workshop and from the usage of the finalized toolkit in Udon Thani. Along with the lack of quantitative data, the small number of samples of the use of the toolkit are the main limitations of this study, which was unfortunately caused by time and budgetary constraints.

The final version of the toolkit was used at a final workshop held on 26 January 2019 with three low-income communities that were impacted by the flooding event in 2011, and other key stakeholders. The selected communities are: Sirin and Friends (Sirin Lae Puean) community in Bang Chak District of Bangkok, Roi Krong community in Bang Kaen District of Bangkok, and Sangsan Nakhon Rangsit community in Rangsit District of Pathum Thani Province. Since the games in the toolkit are participative in nature and focuses on community-specific contexts, members of each communities were grouped together. Each of the three gaming circles were led by a facilitator and were joined by a representative from the Bangkok Metropolitan Administration and a community architect from CODI, who took a more observatory role and helped provide feedback about the toolkit's usefulness as a policy tool. The players were encouraged to use the 'Kin Dee You Dee' toolkit independently, with minimal guidance from the research team. This was successful as almost all participants of the workshop were able to use the toolkit without much assistance from the research team, and every group was able to produce a strategic plan for their communities at the end of the session, which is the desired output of the

toolkit. The participants' feedback and reflections on this experience is discussed in the next section of this paper.

The 'Kin Dee You Dee' toolkit was used again at the end of April 2019 in Amphoe Mueang Udon Thani by the research team, who also facilitated the games, in order to examine the replicability of the experience at the final workshop in BMR. As an emerging urban area in a province that remains mostly rural, Udon Thani has a different context and risk profile compared to the BMR—the main climate-related challenges that they face are related to flooding, drought and managing water resources between urban and rural areas. The participants at the workshop were mostly members of four local communities, who were joined by representatives from the public and private sectors.

4. Results and Discussion

After playing the games in the toolkit, the facilitator asks for feedback from the participants on various aspects of the toolkit and records them for the researchers. This includes asking whether they think that the toolkit is useful and whether they would be interested in further examining or applying some of the concepts that were introduced during the gaming session. More in-depth semi-structured interviews were also conducted by the research team with randomly selected participants in order to better understand the usefulness and effectiveness of the toolkit. The feedback from participants was largely positive, with many of them expressing that they have learned new concepts such as community assets, resources and resilience, which was also confirmed via the debriefing session after the first stage of the toolkit, whereupon the almost all of the participants expressed that there were concepts that they have only discovered through the toolkit as well as concepts that they are interested in exploring further. This suggests that the toolkit was somewhat effective in achieving its goal of increasing the participants' knowledge and awareness about climate risk resilience, and confirming that serious games could enable participants to explore multiple perspectives, reveal values and refine group norms. [47] (p. 142). At the final workshop, participants have expressed their appreciation about how the use of the games is more enjoyable than a conventional meeting or workshop, and that it allows community members to have an opportunity to reflect and voice their opinions. Enjoyment is an important component of serious games as the informal and pleasurable atmosphere encourage openness and increased engagement. The interviewed participants were also satisfied and impressed with how their communities were able to produce a strategic document at the end of the activity.

The majority of participants expressed that the 'Kin Dee You Dee' toolkit could be useful as a tool to help government agencies to better understand the needs of the community. One participant of the workshop commented that "if all communities use this toolkit, they would be able to come together to identify the common problems and seek pragmatic solutions. This would help government agencies to be able to effectively assist the people in a manner that would suit each community's need". Another key stakeholder suggested that "the toolkit can help the government develop the all-encompassing policies that promote resilience, rather than leaving it all up to the communities to deal with uncertain futures". Similarly, a community leader said that they will try to include the questions of community assets and crisis management in their monthly community meetings.

Positive feedback was received about how the 'Kin Dee You Dee' toolkit is effective in enhancing community engagement and interest in community risk resilience. A participant of Sirin and Friends expressed the following:

> "When we were using the toolkit, it demonstrated how many different issues there are to think about. I have never thought about some of the problems before. This toolkit helped us to think about these problems and helps everyone understand what are important resources in or near our community. Every time we play, we increase our understanding of the concept of being resilient to the future."

Another participant highlighted that:

"With the tool, my community would be able to understand what assets they already have. Assets can be everything from community leaders (human) to hospitals (place), something that the community has never thought about when we were planning for any strategy. There are so many different views on how to define or manage the same assets, especially public space. We need to find ways to solve the differences and seek a common goal."

The toolkit was very well received in Udon Thani, in part because of its novelty and how it offered an entertaining learning environment. The four communities were able to produce a strategic plan during the workshop, which included plans such as sorting waste and creating shared public spaces in the community. The discussions during the gameplay were very enthusiastic and allowed the research team to better understand how the different communities identify and perceive various risks. For example, the research team found that all four communities had some ideas about how to cope with more common threats such as flooding, drought and fires, and the communities all prefer to self-organize before reaching out to authorities for help. One community expressed that they would like to focus more on training their community leaders, while another community highlighted the need for supporting the secondary sources of income of their community members.

Naturally, some concerns about the toolkit were also expressed by the participants. During the earlier tests of the toolkit, the research team received feedback about how the gameplay took too long or how it could be more entertaining or easier to understand. At the final workshop in the BMR, a district official commented that "the toolkit creator should adjust the rules of the toolkit to encourage more players to speak more". It was also noted by facilitators in both the BMR and in Udon Thani that in the first stage of the toolkit, many participants were still quite reserved and did not feel comfortable to express their opinions. The participants have a tendency to simply agree with what someone in the group was saying rather than to talk about their own definitions of certain concepts, as requested by the game. Some participants clearly showed that they were scared of being incorrect by trying to look at the answer sheet instead of making guesses or expressing their own understanding of keywords. It was also noted that community leaders and those who have had more experience with activism and development were much more outspoken than those who were not. This highlights the importance of having a facilitator skilled in creating an open and trusting environment where everyone's opinion is valued as well as how there is work to be done to address this issue, possibly through measures such as the modification of game mechanisms or selecting or grouping the participants in a different manner. However, the majority of participants did become more expressive over the course of the games, and almost all of them did not find it difficult to relate the keywords to the context of their own community.

A district official from Phasi Chareon District stated that "the toolkit encourages communities to share and discuss about problems and issues. Activities and tools like this can help the community to move forward. However, the tools like the Kin Dee You Dee toolkit will only reveal views of those who participate. If only a few participate, it would not give the full picture of the risk and vulnerability of the community. The challenge now is how to encourage young people to be involved". This comment highlights an issue that is common in similar attempts to use serious games to engage with the community. In order to create outputs that are representative of different needs within a community, it is important that the game application workshops are as inclusive as possible. This could be accomplished by organizing the activity at different times in order to be able to reach individuals with different working schedules or by directly inviting those who are of an underrepresented group (which could be according to their genders, incomes or occupations, for example).

The experience of using the toolkit suggests that it is effective in achieving broad goals such as enhancing the understanding of key concepts and encouraging discussion and reflection that are useful for fostering community-based adaptation. However, there are

limitations to the evaluation of the toolkit since there is a lack of a more systematic approach to obtaining feedback from players. The use of an anonymous survey, for example, could have been beneficial as it would allow the collection of quantitative data that can be useful for making comparisons of responses from different communities, as well as possibly leading to more willingness of the players in disclosing their critique of the games.

The toolkit is designed to be flexible and scalable, and can be used by government and civil society organizations working with community-based adaptation to environmental risks in different demographic and geographical contexts. Components in the game such as the assets, landmarks and risks can be added to fit the context in which the toolkit is being used. Since the 'Kin Dee You Dee' toolkit was developed within the context of low-income communities in BMR, the experience of using the toolkit with different stakeholder groups in Udon Thani confirms that the toolkit can be used by different participants in different contexts. In fact, after the toolkit was used at the Nong Dae wetland area in Udon Thani, the Udon Thani municipal authority expressed that they are interested in using toolkit themselves. The research team has therefore provided the Udon Thani municipal authority with the toolkit as well as an instruction video explaining how to use and providing training on how to facilitate the games. Another government actor, CODI, has already received the toolkit and the necessary training for game facilitation and will use it for their city-wide housing upgrading projects. The interest from government actors suggests that the 'Kin Dee You Dee' toolkit has the potential to be an effective tool for policymaking and participative planning.

At the moment, the 'Kin Dee You Dee' is in the process of being patented under Thammasat University, and is available upon request on a collaborative basis. If other local government or civil society organizations is interested in using the toolkit for a non-commercial purpose, the research team is open to providing the game and assisting with training the game facilitators. Moreover, after the 'Kin Dee You Dee' toolkit was presented at the 7th Asia-Pacific Urban Forum, the toolkit received interest from participant attendees who would like to use the toolkit in their countries. There are therefore plans to translate the toolkit into English, as it is currently only available in Thai. Moreover, funding has been acquired to develop a digital version of the second stage game of the toolkit, which could help make the game more engaging for certain audiences as well as allowing for the collection of data on the player profiles and responses.

5. Conclusions

The 'Kin Dee You Dee' toolkit that has been developed to enhance community risk resilience through discussions and transformative learning. Through multiple stages of game testing and iteration, the 'Kin Dee You Dee' toolkit was finalized as a toolkit comprising of pedagogical, collaborative and deliberative serious games. The application of the toolkit in the BMR and in Udon Thani suggests that it is a useful tool for engaging with communities that are vulnerable to disaster risks. A qualitative evaluation of the application of the toolkit in the BMR and in Udon Thani province showed that the toolkit was successful in engaging with community members and in facilitating fruitful discussions about community resilience. The experience of using the toolkit also confirms the importance of the facilitator in guiding and moderating discussions, which significantly impacts how much enjoyment and knowledge participants can get from the games. As this study was interested in examining the potential of 'Kin Dee You Dee' toolkit in addressing the challenge of increasing meaningful community engagement and participation and effectively enhancing disaster risk awareness, it can be concluded that the toolkit is quite effective in achieving these desired results. Further research and a systematic evaluation will be useful for the assessment of the impact of the toolkit on a longer-term basis.

Nevertheless, as highlighted by Solinska-Nowak et al. [33], it is important to keep in mind that "[r]egardless of their many advantages, serious games/simulations cannot be treated as a standalone disaster-awareness raising tool. Nor can they replace more standard approaches to education on DRM". The 'Kin Dee You Dee' toolkit will work best as part of

a larger effort in fostering community risk resilience. The research team and OpenSpace design studio will make the 'Kin Dee You Dee' toolkit available to CODI and the National Union of Low Income Community Organisations (NULICO), so that the toolkit can be widely used in their operational and training activities.

References

1.　Dörner, R.; Göbel, S.; Effelsberg, W.; Wiemeyer, J. (Eds.) *Serious Games*; Springer: Germany/Heidelberg Germany, 2016. [CrossRef]
2.　Dimitriadou, A.; Verkuyl, M. Challenges in serious game design and development: Educators' experiences. *Simul. Gaming* **2021**, *52*, 132–152. [CrossRef]
3.　Tilvawala, K.; Sundaram, D.; Myers, M. Serious Games for Sustainable Development: A Decision-Driven Transformative Approach. In Proceedings of the Twenty-fifth Americas Conference on Information Systems, Cancun, Mexico, 2019; Available online: https://researchspace.auckland.ac.nz/handle/2292/48993 (accessed on 2 April 2021).
4.　Bogost, I. *Persuasive Games: The Expressive Power of Videogames*; MIT Press: Cambridge, MA, USA, 2010.
5.　Dalisay, F.; Kushin, M.J.; Yamamoto, M.; Liu, Y.-I.; Skalski, P. Motivations for game play and the social capital and civic potential of video games. *New Media Soc.* **2015**, *17*, 1399–1417. [CrossRef]
6.　Jabbar, A.I.A.; Felicia, P. Gameplay engagement and learning in game-based learning: A systematic review. *Rev. Educ. Res.* **2015**, *85*, 740–779. [CrossRef]
7.　Morschheuser, B.; Riar, M.; Hamari, J.; Maedchea, A. How games induce cooperation? A study on the relationship between game features and we-intentions in an augmented reality game. *Comput. Hum. Behav.* **2017**, *77*, 169–183. [CrossRef]
8.　Ampatzidou, C.; Gugerell, K.; Constantinescu, T.; Martin, B.; Martina, J.; Oswald, D. All work and no play? Facilitating serious games and gamified applications in participatory urban planning and governance. *Urban Plan* **2018**, *3*, 34–46. [CrossRef]
9.　Beattie, H.; Brown, D.; Gjerde, M. Generating Consensus: A Framework for Fictional Inquiry in Participatory City Gaming. In Proceedings of the Serious Games 4th Joint International Conference (JCSG), Darmstadt, Germany, 7–8 November 2018; Springer: Valencia, Spain, 2018; pp. 126–137.
10.　Poplin, A. Games and Serious Games in Urban Planning: Study Cases. In *Computational Science and Its Applications*; Murgante, B., Gervasi, O., Iglesias, A., Taniar, D., Apduhan, B., Eds.; Springer: Berlin/Heidelberg, Germany, 2011; pp. 1–14.
11.　Yamu, C.; Poplin, A.; Devisch, O.; De Roo, G. *The Virtual and the Real in Planning and Urban Design: Perspectives, Practices and Applications*; Routledge: London, UK, 2017.
12.　Archer, D.; Almansi, F.; diGregorio, M.; Roberts, D.; Sharma, D.; Syam, D. Moving towards inclusive urban adaptation: Approaches to integrating community-based adaptation to climate change at city and national scale. *Clim. Dev.* **2014**, *6*, 345–356. [CrossRef]
13.　Ahern, J. From fail-safe to safe-to-fail: Sustainability and resilience in the new urban world. *Landsc. Urban Plan.* **2011**, *100*, 341–343. [CrossRef]
14.　Resilience | UNDRR. Available online: https://www.undrr.org/terminology/resilience (accessed on 4 April 2021).
15.　Magis, K. Community resilience: An indicator of social sustainability. *Soc. Nat. Resour.* **2010**, *23*, 401–416. [CrossRef]
16.　Agrawal, A.; Gibson, C.C. Enchantment and disenchantment: The role of community in natural resource conservation. *World Dev.* **2019**, *27*, 629–649. [CrossRef]
17.　Dale, A.; Ling, C.; Newman, L. Community vitality: The role of community-level resilience adaptation and innovation in sustainable development. *Sustainability* **2010**, *2*, 215–231. [CrossRef]
18.　Abt, C.C. *Serious Games*; University Press of America: Lanham, MA, USA, 1987.
19.　Gugerell, K.; Zuidema, C. Gaming for the energy transition: Experimenting and learning in co-designing a serious game prototype. *J. Clean. Prod.* **2017**, *169*, 105–116. [CrossRef]
20.　Kang, J.; Liu, M.; Qu, W. Using gameplay data to examine learning behaviour patterns in a serious game. *Comput. Hum. Behav.* **2017**, *72*, 757–770. [CrossRef]

21. Medema, W.; Furber, A.; Adamowski, J.; Zhou, Q.; Mayer, I. Exploring the potential impact of serious games on social learning and stakeholder collaborations for transboundary watershed management of the St. Lawrence river basin. *Water* **2016**, *8*, 175. [CrossRef]

22. Tan, A.J.Q.; Lee, C.C.S.; Lin, P.Y.; Cooper, S.; Lau, L.S.T.; Chua, W.L.; Liaw, S.Y. Designing and evaluating the effectiveness of a serious game for safe administration of blood transfusion: A randomized controlled trial. *Nurse Educ. Today* **2017**, *55*, 38–44. [CrossRef]

23. Van der Graaf, J.; Segers, E.; Verhoeven, L. Discovering the laws of physics with a serious game in kindergarten. *Comput. Educ.* **2016**, *101*, 168–178. [CrossRef]

24. Van der Wal, M.M.; de Kraker, J.; Kroeze, C.; Kirschner, P.A.; Valkering, P. Can computer models be used for social learning? A serious game in water management. *Environ. Model. Softw.* **2016**, *75*, 119–132.–132. [CrossRef]

25. Cruz-Cunha, M. (Ed.) *Handbook of Research on Serious Games as Educational, Business and Research Tools*; IGI Global: Hershey, Pennsylvania, 2012.

26. Lean, J.; Moizer, J.; Towler, M.; Abbey, C. Simulations and games. *Act. Learn. High. Educ.* **2006**, *7*, 227–242. [CrossRef]

27. Madani, K.; Pierce, T.W.; Mirchi, A. Serious games on environmental management. *Sustain. Cities Soc.* **2017**, *29*, 1–11. [CrossRef]

28. Soekarjo, M.; van Oostendorp, H. Measuring Effectiveness of Persuasive Games Using an Informative Control Condition. *Int. J. Serious Games* **2015**, *2*. [CrossRef]

29. Fernández, P.; Ceacero-Moreno, M. Urban sustainability and natural hazards management; designs using simulations. *Sustainability* **2021**, *13*, 649. [CrossRef]

30. Wu, X.; Liu, S.; Shukla, A. Serious games as an engaging medium on building energy consumption: A review of trends, categories and approaches. *Sustainability* **2020**, *12*, 8508. [CrossRef]

31. Lankford, B.A.; Craven, J. Rapid games designing; constructing a dynamic metaphor to explore complex systems and abstract concepts. *Sustainability* **2020**, *12*, 7200. [CrossRef]

32. Ouariachi, T.; Olvera-Lobo, M.D.; Gutiérrez-Perez, J. *Serious Games and Sustainability. In Encyclopedia of Sustainability in Higher Education*; Walter, L.F., Ed.; Springer: New York, NY, USA, 2019.

33. Solinska-Nowak, A.; Magnuszewski, P.; Curl, M.; French, A.; Keating, A.; Mochizuki, J.; Liu, W.; Mechler, R.; Kulakowska, M.; Jarzabek, L. An overview of serious games for disaster risk management—Prospects and limitations for informing actions to arrest increasing risk. *Int. J. Disaster Risk Reduct.* **2018**, *31*. [CrossRef]

34. Healey, P. *Collaborative Planning: Shaping Places in Fragmented Societies*; UBC Press: Vancouver, BC, Canada, 1997.

35. Rizzi, P.; Porębska, A. Towards a Revised Framework for Participatory Planning in the Context of Risk. *Sustainability* **2020**, *12*, 5539. [CrossRef]

36. Forester, J. *The Deliberative Practitioner: Encouraging Participatory Planning Processes*; MIT Press: Cambridge, MA, USA, 1999.

37. Archer, D.; Marome, W.; Natakun, B.; Mabangyang, P.; Phanthuwongpakdee, N. The role of collective and individual assets in building urban community resilience. *Int. J. Urban Sustain. Dev.* **2020**, *12*, 169–186. [CrossRef]

38. Marome, W.; Pholcharoen, T.; Wongpeng, N. Developing and Using a Board Game as a Tool for Urban and Social Resilience and Flood Management Planning in the Bangkok Metropolitan Region. *Urbanisation* **2017**, *2*. [CrossRef]

39. Schell, J. *The Art of Game Design: A Book of Lenses*; Peters, A.K., Ed.; CRC Press: Boca Raton, FL, USA, 2014.

40. Sušnik, J.; Chew, C.; Domingo, X.; Mereu, S.; Trabucco, A.; Evans, B.; Vamvakeridou-Lyroudia, L.; Savic', D.A.; Laspidou, C.; Brouwer, F. Multi-Stakeholder Development of a Serious Game to Explore the Water-Energy-Food-Land-Climate Nexus: The SIM4NEXUS Approach. *Water* **2018**, *10*, 139. [CrossRef]

41. Swain, C. *Designing Games to Effect Social Change*; Situated Play: Tokyo, Japan, 2007; pp. 805–809. Available online: http://www.digra.org/wp-content/uploads/digital-library/07311.09363.pdf (accessed on 4 April 2021).

42. National Statistical Office of Thailand. Number of Population from Registration by Age, Sex and Province. 2018. Available online: http://statbbi.nso.go.th/staticreport/page/sector/th/01.aspx (accessed on 20 May 2020).

43. Marome, W. Urban risk and vulnerabilities of the coastal megacity of Bangkok (Working paper). In *Coastal Cities at Risk (CCaR): Building Adaptive Capacity for Managing Climate Change of Coastal Megacities (Vancouver, Manila, Lagos and Bangkok)*; IDRC: Ottawa, BC, Canada, 2013.

44. Kulp, S.A.; Strauss, B.H. New elevation data triple estimates of global vulnerability to sea-level rise and coastal flooding. *Nat. Commun.* **2019**, *10*, 4844. [CrossRef] [PubMed]

45. Duang Pratheep Foundation. n.d. Available online: http://dpf.or.th/en/autopagev4/show_article.php?auto_id=24 (accessed on 20 May 2020).

46. Marome, W. Coping with scarcity and urban water governance: Case of Udon Thani's city region. In *Urban Drought: Emerging Water Challenges in Asia*; Springer: Singapore, 2019; pp. 87–100.

47. Beattie, H.; Brown, D.; Kindon, S. Solidarity through difference: Speculative participatory serious urban gaming (SPS-UG). *Int. J. Archit. Comput.* **2020**, *18*, 141–154. [CrossRef]