
Title	Communal spaces as ludic resources of learning with augmented reality and board games
Author(s)	Kenneth Y T Lim, Yuk Yi Wong and Ahmed Hazyl Hilmy

Copyright © 2021 IEEE

This is the published version of the following conference paper:

Lim, K. Y. T., Wong, Y. Y., & Hilmy, A. H. (2021). Communal spaces as ludic resources of learning with augmented reality and board games. In *Proceedings of the 7th International Conference of the Immersive Learning Research Network (iLRN)* (pp. 1-5). <https://doi.org/10.23919/ilrn52045.2021.9459378>

Communal Spaces as Ludic Resources of Learning with Augmented Reality and Board Games

Kenneth Y T Lim

National Institute of Education
Nanyang Technological University

Singapore

<https://orcid.org/0000-0003-3756-6625>

Yuk Yi Wong

St Joseph's Institution
Singapore

wong.yuk.yi@sji.edu.sg

Ahmed Hazyl Hilmy

National Institute of Education
Nanyang Technological University

Singapore

ahmed.hilmy@nie.edu.sg

Abstract—This paper describes a learning activity using Augmented Reality (AR) which seeks to take advantage of the potential for learning about history and culture through exploration. This is represented by a garden in a university campus that affords visitors a scaffolded experience comprising a game-driven narrative in which visitors to the garden may assume the roles of different protagonists. In addition, we also sought to design a paper-based board-game for visitors who are not yet able to visit the garden in person. Both aspects of the learning activity – namely, the game-driven narratives in the actual garden as well as in the board-game equivalent – were piloted in December 2020. The study suggests that a combination of Augmented Reality, storyline and role-play could increase the probability of encounters with spontaneous elements in learners' local environments that encourage learning.

Index terms—board game, augmented reality, 360 degree photo, outdoor learning, informal learning

I. INTRODUCTION AND BACKGROUND

This paper describes a design a game-based learning environment around a garden at a university campus. The garden was built in the 1950s and spans nine hectares. It was recently re-opened after a renovation lasting about three years. It is situated within the campus of the Nanyang Technological University in Singapore. The renovated garden features clusters of floral species along the water course of a rain-garden – the latter is a bioretention facility designed to treat polluted stormwater run-off, by using plants and differentiated layers of soil to increase infiltration of water which would otherwise pond on the surface. As for the clusters of floral species, they are accompanied by text-based signboards which describe the significance of the various species to the heritage of the Chinese diaspora in Southeast Asia, in cultural terms such as medicinal use, use in textiles, and so on.

The garden was re-opened to the campus community and to members of the general public in early February 2020. Because of the onset of the COVID-19 pandemic, not many have had the opportunity to visit the garden and to learn the histories behind its floral exhibits. The authors responsible for this paper were therefore interested to explore the extent to which a communally shared environmental resource – of ecological, geographical and historical worth – might still be enjoyed and explored during a socio-cultural milieu of limited access and safe-distancing.

II. REVIEW OF LITERATURE

A. Outdoor Learning and Game-Based Learning

The value of outdoor learning has been well documented. Research on outdoor learning has largely come from studies from geography education ([1]-[5]). In geography education, fieldwork serves a vital way in developing geographical understanding of the world ([6]-[9]). Geographic and cultural illiteracy has been linked to a lack of meaningfulness in the learning process [10]. Reference [11] have observed that outdoor learning, if well-designed and rigorously implemented and followed up, can allow students to acquire the knowledge and skills beyond what they would normally gain from classrooms in which explicit and didactic teaching dominate.

Game playing inherently involves the taking of roles. As [12] has argued, role playing and role taking hold the key to players developing a sense of identity. Within the game, the blended character comprises a conflation of the player's own talk and actions with the intrinsic capabilities of the in-game character, constrained in what actions it is able to perform by virtue of how it was programmed. Reflection on the experiences of the externalized, in-game other provides the basis for students to develop an understanding of themselves as the generalized other. This understanding develops as students reflect on and reflect back the consequences arising from actions taken by the externalized other in the game world on themselves. This process of reflection is facilitated through dialogic interplay in the social context of the classroom. Writing a decade before Gee, [13] had already made a compelling case that “[w]hen we step through the screen into virtual communities, we reconstruct our identities on the other side of the looking glass. This reconstruction is our cultural work in progress” (p. 177). In the game-based learning environment that is the focus of this paper, the looking glass that players are invited to step through takes them through the pages of history to the characters of a doctor, artist, and farmer from the 1960s. This period of history is of particular significance to the university within which the garden is situated because the university was founded in 1955. Following the events in East Asia after the Second World War, the Chinese diaspora in Southeast Asia supported the founding of the Nanyang University. Setting the game characters within this time period thus affords potentially rich historical and cultural tapestries to be woven by present-day protagonists.

B. Augmented Reality and Learning

The renovated Yunnan Garden itself forms a rich backdrop to the storied cultural tapestries potentially at play. The plan view of the garden reveals a series of trails in geometric patterns – this design element is drawn from those of traditional Chinese gardens. These trails align well with affording the semi-structured narratives of a board-game. The design decision was made to use Augmented Reality in order that this palimpsest of tapestries might be introduced to the learners in a more scaffolded manner. Augmented Reality overlays digital information onto the real environment around us [14]. Construal level theory and its related concept of psychological distance are useful in explaining how individuals conceive of an event beyond one’s direct experience, such as an experience mediated by technology. Psychological distance refers to the sense of distance we have from a target object, person, or environment [15]. The theory proposes that the closer we feel to the target (i.e. low psychological distance), the more concretely we can picture the target (i.e. low construal) [16]. Augmented Reality would help to increase psychological closeness to the historical and cultural narratives implicit in the garden, thereby affording players with a more grounded context of learning.

III. DESIGN OF INTERVENTION

The present authorial team decided to design a learning activity using Augmented Reality (AR) which sought to take advantage of the implicit potential for learning about history and culture which the Yunnan Garden represents, so as to afford visitors a scaffolded experience as they explore the garden. This scaffolded experience comprises a game-driven narrative in which visitors to the garden may assume the roles of different protagonists.

In the context of visitors to the actual site of the garden, game-play through this activity took the form of the players exploring the trails on quests aligned with their respective character roles. They play the game using a location-aware (via GPS) app on their handhelds / smartphones, which presents them with game challenges and clues based on their location within the garden. An example of such a quest might be – in the role of the doctor – to learn about herbs which might be used as soothing balms.

In addition, we also sought to design a paper-based board-game for visitors who are not yet able to visit the garden in person. For those times during which visits to the Yunnan Garden may neither be possible nor practicable, in the parallel context of players of the board-game-based iteration of the activity, they would participate in similar quests, scanning Augmented Reality codes on cards drawn in the course of game-play; players would need to decide if and how to use the information from the cards to advance their progress in the game. The layout of the board-game approximately mimics that of the actual garden, and Augmented Reality is used to complement game-play by providing the player(s) with supplemental information as they advance through the game.

Both versions followed similar narrative contexts, educational material and utilised the same character roles, the last of which encourages collaboration by providing the grounds for positive interdependence amongst the players. Meanwhile,

one notable difference lies in the use of a board game medium for the intersection of Augmented Reality and explorative learning in the paper-based game, that is otherwise directly combined in the on-site version.

A. Design of the At-Site Experience

The game was designed using a web-based AR game creation tool, TaleBlazer (www.taleblazer.org/) developed by the Scheller Teacher Education Program (STEP) lab at the Massachusetts Institute of Technology. It was then played using the mobile application version of the platform.

The mobile application was designed to complement the players’ real journey in the garden, providing a playful and informative aspect to their physical exploration.

The game was designed to have co-operative attributes, affording participants a choice of characters to play. It included optional tasks which players could only complete collaboratively. The on-site game can thus be played alone or with other people with its optional co-operative multiplayer content. Fig. 1 depicts one such example of a task, namely to identify and dispose of an in-game flower which does not belong in the Orchid Garden.

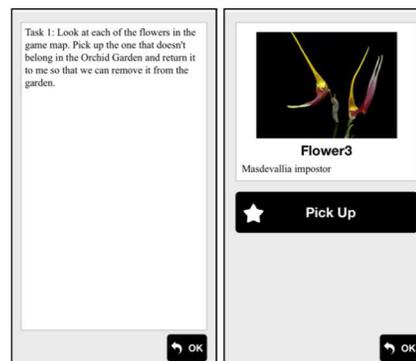


Fig. 1. Screenshots depicting identification of local flora at-site

The game map uses the satellite view of the garden, using icons to mark out specific trails. Once certain tasks were completed, the next trail would be unlocked.

Compared to the board game version, the use of Item Cards (ICs) – essentially the flora collected in the game by the players – played a more prominent role in the at-site version of the game.

B. Design of the Board Game

Compared to the on-site version, this game was made more complex as we sought to maximise the possibilities of experiential and collaborative learning in a board game, with the recommended number of players being two to four. Players select one of four characters to play as in the game, namely a Hawker, Farmer, Doctor or Artist. The game involves a tokens system, in which Science, History and Art tokens would be collected by the players in order to fulfill their Personal Goal Cards (PGCs). PGCs are unique aims that each player needs to complete– by rolling a dice three times, the players determine the number of Science, History and Art tokens they need to return home and endeavour to reach these goals. These tokens can be collected through successfully completing Challenge Cards (CCs) and attempting Conversation Cards (CoCs). They

provide competitiveness to the game, though players can still decide if they wish to involve this aspect. There is also the larger, collective aim of filling an ‘Energy Bar’ with ten ‘Energizers’, obtained from completing Challenge Cards. Item Cards are present in the game and can be used to complete certain Challenges.

Certain trails from the Yunnan Garden were photographed to set the scene for the game. There are a total of six scenes, with several Information Cards (InCs) and Challenge Cards in them. For each scene, players each have one to three turns (depending on the number of players). They would use these turns to select either Information Cards or Challenge Cards and read or attempt these cards once uncovered. They can choose to share the information or attempt their Challenges with other players. At times, certain Information Cards and Challenge Cards have Conversation Cards that follow them. Players are not allowed to show others the cards that they pull, rather, any information they wish to convey should be spoken, to enhance the interactivity of the game. Players can show the Conversation Cards to the relevant parties involved in the conversations, though they need to be read aloud.

The tokens are shaped as triangles, pentagons and hexagons to represent Science, Art and History respectively. A yellow circle represents one Energizer, to be placed onto a yellow bar to track the players’ progress at filling it. Scenes are split into four parts, each called Scene Card 1 to 4, to better categorise the Item Cards and Challenge Cards. The layout of the board game is depicted in Fig. 2.

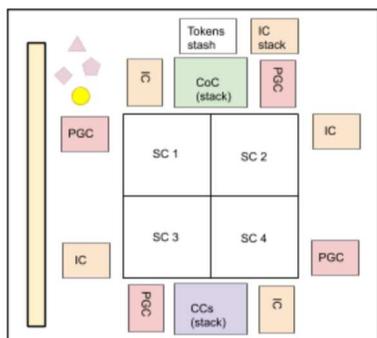


Fig. 2. Layout of the board game

In order for all the characters to return home, the Energy Bar has to be filled with at least ten Energizers by the last scene, along with the Personal Goal Cards. Otherwise, only those who have filled their Personal Goal Card requirements can travel back. If this has not been accomplished, the entire team fails. Players can replay the game to try to win, uncovering different Information Cards, Challenge Cards and using their newfound knowledge to obtain sufficient tokens and Energizers in time, thus undergoing a form of experiential learning.

This version involves a solely co-operative gameplay that facilitates a totally simulated exploration of the Garden, furthering the idea of the jigsaw teaching technique by supporting interdependent play.

C. Design of the AR Aspects of the Game

The at-site version of the game (played using the mobile application TaleBlazer) and the board game use different AR

technologies to suit the needs of the respective learning experiences.

The TaleBlazer mobile application uses GPS to track the players’ locations within the garden. As players explore the garden, the app pops up notifications with new game content (such as quests or clues) whenever they move close to particular locations (such as trails or pavilions). Certain quests require players to pick up items from one area and place them down in another area. When a player places an item (using the app interface), the app then checks the distance between the player’s location (where they placed the item) and the goal area (which had been pre-designated by the authors using the web-based TaleBlazer game creation tool).

In contrast, Google Expeditions was used for the AR aspect of the board game. 360-degree photos were taken of specific spots in the garden and inserted into the programme. Along with some other textual resources, these were made digitally accessible via QR codes on some of the Information Cards and Challenge Cards. By referring to the related cards, players could enjoy a highly visual, educational and explorative experience away from the garden.

IV. METHODOLOGY

This study was conducted under the auspices of a year-long internship attachment programme by the Nanyang Technological University for high school students in Singapore. Both aspects of the learning activity – namely, the game-driven narratives in the actual garden as well as in the board-game equivalent – were piloted in December 2020.

In order to have a clearer idea of the participants’ experience with games, their responses to “Would you consider yourself a gamer, or someone who enjoys playing games regularly (e.g. board games, video games, physical games etc)?” and “What kind of games do you enjoy playing?” were sought. Apart from one participant – Participant A, respondents answered the former question in the affirmative. The most popular types of video games received five votes: Action-Adventure, Adventure, Roleplay, Strategy and Puzzle. For board games, Mystery / Secret Identity was the most popular with four votes.

Because of the constraints on social interaction prevailing through 2020, participants were invited on the basis of convenience. Three male undergraduates from the university participated in the at-site game within Yunnan Garden itself, while four female Grade Eleven students from a local high school played the board game at a location remote from the university campus. The at-site game was piloted once, over a duration of an hour. The board game was piloted over two sessions, two days’ apart. The first session was 90 minutes in duration, and the subsequent session was an hour in duration. The board game was iterated to add more Conversation Cards, and character descriptions were added with the intention of helping participants feel more invested in their respective roles.

The intent of the study reported in the present paper was therefore purely to pilot the approach and its associated technologies and materials. The non-representative nature of the participants dictated a qualitative research methodology, and the views of participants were solicited through online forms.

V. FINDINGS

The players were able to grasp the concept of the game relatively quickly, however, it took them slightly longer to adjust to the game mechanics (with respect to the board game, the participants were more familiar with the game in the second session, remembering the contents of the cards that they had played, though the second session was carried out two days after the first. The Conversation Cards were especially memorable to them).

The first few questions of the survey represented an attempt to profile the dispositions of the participants towards exploration in general. Thus, one question was “Do you like to explore new places?”, which was answered by all participants in the affirmative. The next question was “What are some issues and / or limitations you face when you explore new places?” The most frequent response was ‘Remembering very little information about the place despite reading the information boards’, selected by half of the participants. This was closely followed by a tie between ‘Only having a surface-level understanding of the place’ and ‘Having nowhere to rest during your exploration’, with four votes each. The third most selected option was ‘Navigation difficulties’. The subsequent question was “How have you attempted to overcome these issues and / or limitations?” The participants’ responses to this question is tabulated in Fig. 3.

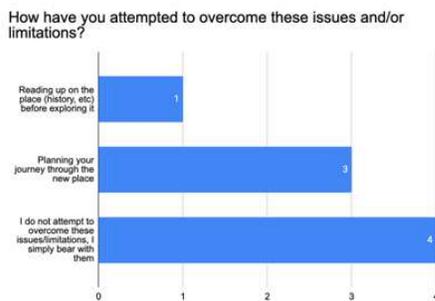


Fig. 3. Responses to “How have you attempted to overcome these issues and / or limitations you face when you explore new places?”

From the top to the bottom bar, the response options are: ‘Reading up on the place (history, etc) before exploring it’, ‘Planning your journey through the new place’ and ‘I do not attempt to overcome these issues / limitations, I simply bear with them’. Most respondents chose the last option, followed closely by the second. The last option seems to reinforce the need for some kind of interactive and memorable stimulation to aid these participants to appreciate and engage in richer knowledge acquisition.

Finally, participants’ views were sought on the actual experience of gameplay – be it at-site within the Yunnan Garden, or, off-site with the board game. Participants were asked “After playing the game, do you feel like you know the Yunnan Garden and / or NTU better?”, to which they all answered in the affirmative. To the question “Would you rather play this game to learn more about a new place, or read information boards about the place, assuming you have no time constraints?”, most respondents apart from Participant B expressed a preference to play the game.

To the question “How do you feel about using this activity that you have just undertaken today as a means to learn more about a place?”, there was an overall positive reception to both versions of the game. The on-site version was described as an interactive option for learning about a place, “memorable” and “immersive”, framed well using a storyline. The board game version was said to be “a very comprehensive way to direct [one] around the garden”, “entertaining” and inclusive, as one respondent wrote it would be preferred over a physical walk-through for those with eczema. Notably, Participant A – who had expressed a general dislike of card games – found the game “dynamic and engaging, despite its heavy use of cards”.

The last question participants were asked was “With 1 being the lowest and 10 being the highest, how fun did you find the game you played today?”. To this, the three respondents who played the on-site version of the game answered with an average of about 7.3. Participants for the board version answered with an average of 8, then 9, for the first and second rounds of playing respectively. Based on such anecdotal evidence, it would therefore appear that the board game version may have a slightly higher appeal to players than the on-site version. A participant wrote that the hot weather on the day of playing the on-site version made him feel like rushing through it instead of taking his time to fully explore the game and the garden. Furthermore, another participant commented that the interface could be somewhat counter-intuitive. For the board game, the players were more engaged with the storyline and game features. However, from field notes taken during gameplay of the board game, the Item Cards were considerably overlooked in the first round. Despite this, their gameplay experience remained smooth-sailing and enjoyable. The board game participants greatly enjoyed the collaborative aspect of the game, the character roles and the Conversation Cards. They also appreciated the storyline, the challenges and the interdisciplinary way of learning.

VI. DISCUSSION

The limitations of the responses to the survey described in the preceding section are acknowledged and no attempt at generalizability from this pilot is imputed in this paper. Were prevailing protocols for social interaction more permissive, a robust study would have been designed and conducted.

Further, the then-current iteration of the on-site version suffered from having too many notifications and having technical issues, namely challenges being presented to participants when trying to exit the former, and nothing happening after dropping Item Cards. A participant suggested it could be better for the game to focus more on the plants grown on-site instead of on the information boards as well. For the board game, participants felt that there were insufficient opportunities to explore the entirety of the gardens (e.g. through the challenges); they also felt that there was reliance on guesswork to respond to Challenge Cards (due to the lack of a direct incentive to look at the Information Cards), and they reported finding difficulty in attaining Item Cards.

The preceding caveats notwithstanding, the results do suggest potential in the gamification of communal spaces for educational purposes. Ludic resources of learning with AR and board games can be effectively developed in such areas. One

prominent feature of such resources would be the incorporation of a storyline and roleplaying, both of which were present in the backbone of the two versions of the game, and of which the participants appeared to be most captivated by. The roleplaying aspect was underlined with the Conversation Cards, which participants found to be fun and interactive features of the game. Thus, interactiveness should be intrinsic to the game. Notably, the elements of storyline and roleplay are also present in numerous popular content-heavy or complex games, such as T.I.M.E. Stories, Pandemic and Risk. With the use of AR, the players could strongly immerse themselves in the learning environment. AR was also able to sharpen the educational aims of the games; for instance, in the on-site version, the presence of flora was highlighted to the players, who had to consciously collect or drop it, conducting an action that placed them between the real and virtual space. In the board game version, QR codes linked participants to 360-degree views of specific spots in the garden, enabling them to absorb information in hyper-reality, namely interacting with a reproduction of a real garden digitally within a roleplaying board game. While the games were conceived from educational content in the Yunnan Garden, learning was sustained through the gamified environments created.

We then consider the effect of the learning setting in the implementation of both forms of gameplay and the method of Augmented Reality in such contexts. Both versions enable players to simultaneously engage in a virtual and physical space, providing a flexible, safe space for players to experiment and learn in their environment. This close interaction provides a hermeneutic form of learning that potentially enables more dynamic methods of knowledge acquisition in players, encouraging our investigation into the field of game-based learning. In the on-site gameplay, Augmented Reality acts as a form of functional augmentation of the landscape. This transforms the garden into an educational playground that encourages a kinaesthetic form of learning. On the other hand, the paper-based game uses Augmented Reality to centre on a more academic form of learning, as demonstrated through the labelling of real plants and objects. This appeals to visual learners and possibly students who prefer an actively social environment for learning due to its highly interactive, interpersonal nature.

VII. CONCLUDING REMARKS

The study suggests that using a combination of Augmented Reality, storyline and role-play, along with an overall interactive gameplay nature could increase the probability of encounters with spontaneous elements that encourage learning, essentially enabling game-based worlds and immersive environments that incorporate these features to be ludic resources for learning.

Further developments in design could involve the addition of Augmented Reality elements that show 3D models of objects required for current tasks in both versions. Moreover, this technology could also be utilised to design animated tasks that

could add to visual appeal and / or task complexity and engage players further in the process of learning. In the area of future research plans, including detailed analyses of learning processes and outcomes into future evaluations could be valuable to research on the effects of similar gameplay. Moreover, a larger sample size of players from diverse groups could be useful in observing any differences in stimulation from such games, enabling educational communities and game developers to create games tailored to any specific education trends in various consumers.

REFERENCES

- [1] Black, R. Delivering formal outdoor learning in protected areas: A case study of Scottish Natural Heritage National Nature Reserves. *International Research in Geographical and Environmental Education*, 22(1), 4-22, 2013.
- [2] Boyle, A., Maguire, S., Martin, A., Milsom, C., Nash, R., Rawlinson, S., . . . Conchie, S. "Fieldwork is good: The student perception and the affective domain". *Journal of Geography in Higher Education*, 31(2), 299-317, 2007.
- [3] Cook, V. "Year 9 students' perceptions of geography fieldwork". *Teaching Geography*, 33(2), 72-74, 2008.
- [4] Dymont, J. E. "Green school grounds as sites for outdoor learning: Barriers and opportunities". *International Research in Geographical and Environmental Education*, 14(1), 28-45, 2005.
- [5] Kwan, T., & So, M. "Environmental learning using a problem-based approach in the field: A case study of a Hong Kong school". *International Research in Geographical and Environmental Education*, 17(2), 93-113, 2008.
- [6] Foskett, N. "Teaching and learning through fieldwork". In D. Tilbury & M. Williams (Eds.), *Teaching and learning geography* (pp. 189-201). London & New York: Routledge, 1997.
- [7] Gerber, R., & Chuan, G.K. (Eds.). *Fieldwork in geography: Reflections, perspectives and actions*. Dordrecht: Kluwer Academic, 2000.
- [8] Hope, M. "The importance of direct experience: A philosophical defence of fieldwork in human geography". *Journal of Geography in Higher Education*, 33(2), 169-182, 2009.
- [9] Scott, I., Fuller, I., & Gaskin, S. "Life without fieldwork: Some lecturers' perceptions of geography and environmental science fieldwork". *Journal of Geography in Higher Education*, 30(1), 161-171, 2006.
- [10] Reffell, J. A., & Wells, K. A. "Geographic memory bubbles: Recall of the fifty United States". *Current Psychology*, 31(2), 212-220, 2012.
- [11] Rickinson, M., Dillon, J., Teamey, K., Morris, M., Young Choi, M., Sanders, D., & Benefield, P. *A review of research on outdoor learning*. Slough: National Foundation for Educational Research and King's College London, 2004.
- [12] Gee, J. P. *Good video games and good learning: Collected essays on video games, learning and literacy*. NY: Peter Lang, 2007.
- [13] Turkle, S. *Life on the screen: Identity in the age of the Internet*. Simon & Schuster, NY, 1995.
- [14] Goldman Sachs. *Virtual & augmented reality: Understanding the race for the next computing platform*, 2016. Retrieved from <http://www.goldmansachs.com/our-thinking/pages/technology-driving-innovation-folder/virtual-and-augmented-reality/report.pdf> on 30 December 2020.
- [15] Trope, Y., & Liberman, N. "Construal-level theory of psychological distance". *Psychological review*, 117(2), 440-463, 2010.
- [16] Bar-Anan, Y., Liberman, N., & Trope, Y. "The association between psychological distance and construal level: Evidence from an implicit association test". *Journal of Experimental Psychology: General*, 135(4), 609-622, 2006.