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Game-based learning to teach Higher Order thinking in Rural Schools: Case studies in Sarawak Borneo

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Abstract. This action research utilised game-based learning principles in rural schools in Sarawak. Game design thinking was proposed as a pedagogical approach to guide teachers to address Higher Order thinking skills in subjects they teach, a requirement in the current national curriculum. Due to the lack of resources, facilities and training commonly faced by rural schools, the initiative was necessary to measure the feasibility of the approach for learning. The study also observed the similarities and differences in local cultural protocols as they differ by location, and adjustments were made to the presentation of Game Design thinking to accommodate community expectations and support. The study proposes a CreativeCulture model, an instructional approach which accommodates inclusive needs of indigenous communities in Sarawak, both within and beyond their local schools.

Keywords: play, game-based learning, game design thinking, cultural protocol.

1 Introduction

Play is universal, and so is learning. The contention to play and learn is to get involved, and if luck has it, succeed. Design thinking is a cognitive approach to examine options, strategies and resources one has to construct new ideas and experiences. With design thinking, the process to build becomes tangible as each phase is dissected to inform and prod for more cognitive and affective responses to take place. Design thinking enables an opportunity to create a learning environment which considers a responsive approach to how learners engage with learning content. In this study, games are used as a tool to engage in Design Thinking. A pedagogical approach is introduced to provide a playful connection to the learning experience. In this study, Game design thinking was presented to teachers of rural schools in Sarawak. The demographic profiling of each location is unique to each, and local cultural protocols were observed, to enable the study to be implemented and to gain support from the community, parents, teachers and students.

As context, the Malaysian Education Blueprint (MEB) 2013-2025 spelt out the need to develop High Order Thinking Skills (HOTS) of students in primary and secondary education [1], and elements of higher-order thinking are expected to be

illustrated in daily lesson plans. However the journey to incorporate higher-order thinking skills in lessons has not been a smooth one; teachers, already bogged down with administrative burden and the race to complete syllabus in each class they teach, often do not permit adequate time and effort to engaged learning, let alone nurturing higher-order thinking. In Malaysia, the push to achieve the most top scores in national examinations has invariably affected the way classroom climates have been conceived and conducted in Malaysia [2]. Students are focused on completing the prescribed syllabus, often challenged by time and effort to complete the learning contents. Simultaneously, higher-order thinking skills are emphasised as essential for better content retention and lifelong learning. However, to achieve higher-order thinking skills, stimulators and classroom climates are necessary to enable the development and sustenance of learning through the engagement of creative and critical thinking. The situation is doubly complicated in a context as geographically, culturally and socio-economically diverse as Malaysia, where top-down, state-level educational strategies and national curricula often require synergy by teachers to make learning fully accessible and meaningful for particular sectors of the population or specific communities. Higher-order thinking cannot be taught through rote learning, and passive engagement [3] with an externally mandated, top-down curriculum detached from real contexts, but can instead thrive only by being firmly rooted in local needs, practices and community values.

Like [4] and, more recently, [5, 6] suggested there is, however, an inherently higher-order frame of thinking that is common and practised across all human cultures, that is, that of playfulness. Playfulness supports at the same time abstraction (in the form of “make-as-if” and game rules, for example; see [7, 8] and context-sensitivity (in terms of being able to situate play within a culture and a community of peers; see [9]), and therefore acknowledging and fostering the play element in learning can be theorised as a strategy to induce (creative and critical) higher-order thinking, and at the same time a powerful approach to bridge the different cultures expressed by the curriculum, the teachers and the students through localised co-design. That is, if we intend to foster higher-order thinking as a bridge between cultures and approaches to the curriculum, our study aims to showcase how a plausible way of doing it is to use locally created games as bridges between the local and the global, the particular and the abstract (see [10] for a similar study of playful cross-cultural design, as applied to the field of advertising). With existing pressures to perform academically in standardised tests such as PISA, it has never been timelier and more relevant to fuse global perspectives of academic achievement through the use of local and familiar elements.

The study, comprising fieldwork in a variety of communities across Sarawak Borneo, contends therefore that when games are locally co-constructed by teachers and students, the engagement with abstract, curriculum-mandated learning contents becomes more intentional and directed, and yet remains playful, emotionally relevant and grounded.

The research was intentionally purposed to gauge the feasibility of introducing playful learning at remote rural sites in Sarawak. The idea behind the selections of remote rural schools is that they presumably face the hardest challenges in terms of access to resources, teacher training, internet connection and economic affordances within their communities [11]. Some of the communities involved in the research project are indeed quite remote and participate in broader socio-economic processes only from the side-lines, and often in ways that limit the political, economic and individual agency.

2 Research Setting

The Penan community of Long Lamai is the most critical example of this dynamic within our study: a community of about 400 people built on the Bayung river, in the jungles at the border between Northern Sarawak (Malaysia) and Indonesia, Long Lamai is in many ways built around its church. The community frequently flocks to the primary school, which is a point of gathering and convergence for the partially nomadic populations of the local area, with the kids spending a large part of the year boarded there. The primary access to the community is by the river, one hour and a half journey on a two-seater longboat. Over the past decade, the Long Lamai's people have repeatedly rejected proposals to build a road reaching the village, as they fear the consequences of opening up the area for the logging industry, which has been a longstanding problem for the Penan populations. In doing this, however, they also partially secluded themselves. They have a long-standing affinity with the jungle, where they forage most of their meals. They plant their rice alongside the hills surrounding their locality and grow their vegetables. The men go out to hunt, while the women stay home to look after their young. In recent years, the women have started going into the forest to look for rattan, a material they use to create handicrafts that are then sold in towns.

This contrast is nowhere as apparent as within the school itself: while all the kids are from local families, living both in Long Lamai and its surrounding areas, most of the teachers come from a very urban background (some of them having studied in Kuala Lumpur) and are young majority teachers. Most would have just completed their teaching degree in West Malaysia, and Long Lamai would be their first teaching assignment, having been offered the job right after earning their degree, these young teachers would not have much choice in their destination, and live both at the heart and at the periphery of the community (more insight into the experience of teachers will be provided in a later paragraph).

Their local school is made up of approximately 32 students (N=32), ranging from year 1 to year 6 (seven to twelve-year-olds). All students who attend the primary school are from the Penan village itself, and ethnically homogenous. All students live at a school dormitory; they have meals with their teachers and learn to take up chores around the school and dormitory.

The second rural location is Telok Melano, situated at the tip of Sarawak, approximately 120km from Kuching, the capital city of Sarawak. The Malay community in Telok Melano is primarily small-time farmers and fishermen. They mainly grow their vegetables. Men are the primary breadwinners in the family, and wives stay home to care for the young. They occasionally receive guests for local tours to the nearby Tanjung Datu National Park. The village is made up of approximately 300 people, and for decades they have lived without basic amenities such as water and electricity due to their geographical location. The village was established by a Pak Dukun Dollah in the 1920s, and the majority of its community originated from Semudun, Indonesia. The village has close ties with a township in Indonesia, called Temajuk. Telok Melano was once unconnected to the rest of Sarawak, and the only way to reach and leave the village was via a 30-minute boat ride to the nearest town, Sematan. At the beginning of January 2019, a new road has been opened to the public that connects Telok Melano directly to the rest of Sarawak.

The local school is made up of approximately 36 students (N=36), ranging from year 1 to year 6. The students are allocated spaces in the school dormitory, but at the time of research, none of the students resided at the school dormitory. They preferred to live with their parents, and were only present at school during school hours. Teachers at the school originate from other parts of Malaysia; most are from West Malaysia. In Malaysia, teacher training typically takes between to three years at local

teacher training centres. The teachers at Telok Melano are of a similar background to those in Long Lamai. None of them originates from the local community.

Both schools' examination performances are similar, in that very few of their students would score A's in the national examination typically held at the end of Year 6. Such academic achievements depict the ability of students from these schools to participate in higher education and high-skilled jobs in the country.

3 Game-based Learning & Culturally Sensitive Co-design

Game-Based Learning is now a mature approach that has been fruitfully deployed across a wide variety of contexts and at all levels of education (see, among others, [12-16], including rural ones [17, 18]). Despite its increasingly widespread success, particularly in terms of enhancing active engagement with learning materials (see [19]), it has also encountered a variety of obstacles which, as pertaining our study, can be usefully framed under three main categories:

- Institutionally, there is still a strong stigma toward games and playfulness, especially when trying to make this approach fully embedded and mainstream. Curricula and school management systems are often built within a culture that values "seriousness" [20], and particularly within the current regime that emphasises standardised testing and quantifiable quality assurance, the introduction of playful element, especially those involving an aspect of design and not "ready-made" can often be perceived as a waste of already scarce time and resources [21].
- Technologically, game-based learning has, until now, shown a definite slant toward digital games, mostly due to contingent factors in its development as a pedagogical approach [22]. It is doubly problematic, in that it both limits the design repertory of perspective game-based learning designers and can be exceedingly challenging to deploy in areas where digital technology is not broadly available or used, due both to economic and infrastructural considerations.
- Culturally, and most centrally to the discussion of this paper, the vast majority of game-based learning artefacts is built from a strongly Westernised repertory of both design patterns and pedagogical approaches [23], therefore not only limiting its accessibility to students and teachers from different cultures but also functioning as yet-another colonial influence on curricula, made only more insidious by its playful "friendliness".

In the case of the study, play was used to tease out interactions with the communities. Traditional games were sought and discussed, and members of the community came out and demonstrated to the research team how they played their games. On the side, the womenfolk of the community observed and offered folklores they tell their young. They played musical instruments which they have constructed from natural resources, primarily bamboo, and sang tunes which bore stories they knew by heart.

At the local school, the children from the communities attend the school as part of their educational journey. It was apparent how close the relationships were between the students and their teachers. They interacted frequently, and students displayed a high sense of respect for their teachers. In Long Lamai, teachers would hold special classes for parents and members of the community, to help them learn to read and

write. The bond between teachers and parents was evident in the way they kept in touch about students' progress and well-being.

While it is necessary, if these communities intend to survive and thrive in their environments and socio-spatial existence, to provide them with the conceptual and technical tools to fully and meaningfully participate in the broader global arena, to do this in a directive and instructional way would constitute yet another wave of colonialism, and an insidious push toward displacement, as in many cases their native communities would not be able to provide appropriate jobs at the government-suggested level of computational literacy.

4 Methodology

Coherently with the layered structure of our action research, our method was composite and layered, with different approaches being deployed in successive moments of our engagement. In the first steps of the process (before and during the onboarding phase), more formalised methods, such as group interviews were conducted to analyse current conceptions about learning and education in general. Local youths were engaged to assist in the first canvassing activity, as trust needed to be built and developed before engagement is done.

Ethnographic observation, conversation and writing were deemed most appropriate to explore the higher-order levels of engagement in the community. The research team spoke to a variety of community members (n=30), mostly parents and elders who have and are still sending children to the local school. The teachers were also interviewed (n=10), beginning with the school principal and his deputy.

Findings from the interview data revealed several insights into how knowledge is valued within these two communities:

- a. High interest to learn Malay Language, Science, Mathematics, English Language and Art -students admitted to having a lower interest to learn the English language in comparison to Malay, but they are well aware that they need to master the language to succeed in school and life in general.
- b. Positive outlook about collaborative learning – students recognised the value of working together with friends while studying, as it was perceived to be “fun, enjoyable” and they believe they can “perform better when studying with their friends”. Teachers are positive about collaborative learning, as they perceived collaboration to be useful to help their students “perform better, improve communication skills, understand learning content better, improve critical thinking skills” and consequently improve learning opportunities.
- c. Gaps between community values and formal learning contents – community leaders who were interviewed expressed their perceptions about the values of knowledge their young children learn at school. Though they understood the need to learn contents from the national curriculum to excel in school, they saw how their young generations who have completed school and were not able to contribute to daily tasks and expectations within the community. As they have lived in school dormitories while attending primary and secondary schools, once they finish school, they are not able to farm, fish or hunt.
- d. Playing to learn – teachers who were interviewed revealed that they have not thought of integrating game elements into their teaching

approaches or resources. The teachers were not familiar with traditional games that exist in the local communities, as they perceived their students were more keen to play mobile games rather than traditional games, which are more physically challenging.

Primarily the interactions led to a better understanding of the community's general conceptions about the importance of education to their community.

5 The CreativeCulture Model

The CreativeCulture model (as shown in Fig. 1.) was constructed as an output of observations made throughout the research to introduce game-based learning to the local schools. It is essentially a STEAM-driven Game Design and Computational Thinking programme (the CreativeCulture Lab), that uses (digital and analogue) game design and development process to facilitate 'learning by designing', providing the means/toolkits for the beneficiaries to co-design and produce games within the context of STEAM and culturally related topics. This programme will be iteratively developed and tested, which will subsequently be adopted/adapted by the schools and the local communities as part of formal/informal learning activities. The resources required to support the programme will be hosted on an open repository (the CreativeCulture Hub) of toolkits (including the adaptable CreativeCulture programme, open-source game design/authoring tools) and game-based resources (produced by the participants during the participatory studies), which will be open and free so that they can be shared, reused, remixed and repurposed by the communities (e.g. teachers, learners, schools, etc.).

Our process of engaging with schools, students and the broader communities is layered and always two-directional throughout our study, as showcased in the above framework. The two directions represent two juxtaposed and often conflicting currents ever-present within our approach:

The ascending current is that of **Abstraction**, generated by trans-contextual factors, such as the systems-oriented and computational nature of the playful artefacts created throughout the project, their linkage with the nation-level curriculum contents, and our attempt to draw re-usable guidelines from our local engagement that can be fruitfully applied to set similar game-based learning co-design processes in motion in very different contexts. The ascending current signifies the start of our journey to understand elements within published theories on Gamification and established syllabus used in the local schools. We began with available artefacts to provide context to the study, through an emphatic needs analysis and creative ideation.

The descending current is that of **Indigenisation**, generated by necessarily contextualised factors, such as the need to refer to locally known playful artefacts, to integrate local indigenous curricula and perspectives on learning, to engage with the often very specific needs and cultures of local communities, and by our intent to respect and integrate local cultural attitudes and practices in both play and education. We termed the descending current as Indigenisation because it represents our sociocognitive observation of existing gaps between published theories and local wisdom and practices. The indigenisation process has to take place to present elements within the Game-based Learning approach in harmony with local community values, beliefs and needs. Cognitively we observed how new ideas may lead to confusion or resistance from within the local community. Indigenising the ideas into chunks of knowledge which are palatable for the local community was decided by the team, to create familiarity among the community members.

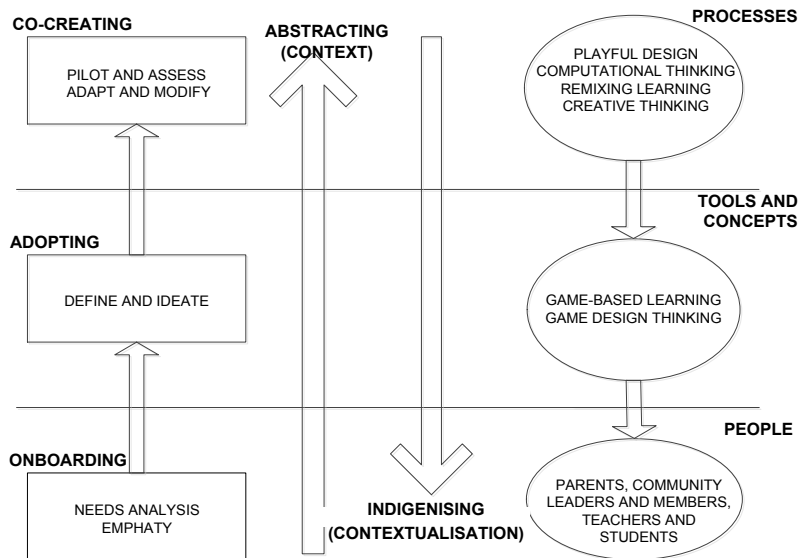


Fig. 1. *CreativeCulture Model is a product of synthesis from experience conducting Game-based Learning at rural schools in Sarawak.*

Despite this ongoing circularity, integral to co-design processes in general, the process of engagement with local communities has a starting point and absolute path, as showcased by the left side of the model.

The first stage of this path is that of **Onboarding**. It focuses on the most practical and material aspects: the infrastructural situation of the specific learning community in terms of socio-economic capital, teaching personnel and technology, and their needs in respect both to the national (formal) and local (informal) curricula.

The second stage is that of **Adopting**, which pertains the use of tools and concepts at the institutional level: the weaving of game-based learning and design thinking conceptual tools into standard school practices and frameworks, and the active engagement with iterative co-design practices on both teachers and students' sides. In this stage, the critical challenge is to enable the articulation of connections made between existing curricular content and needs, and the playful elements that are suitable to increase engagement, comprehension and dialogue in the learning process.

The highest order of engagement, **Co-creation**, is the hardest to achieve. It is the one towards which this project is still working on, but also the one most key to the sustainability, relevance and ethical resonance. It entails the full integration and "remix" of local playful practices, artefacts and informal learning within the playful co-design framework so that playful objects can be created that bridge local, national and global cultures, traditions and curricula. The outcome of this process is for the locals to fully and reflexively appropriate the tools, both technical and conceptual, of game-based learning co-design. This means going beyond being trained into their use for purposes that are not necessarily harmonised with their cultures and ways of life. As [24] suggest, the final objective of this game-based learning co-design process is, therefore, to move away from simple computational thinking, as required and framed

by government-led attempts to address a perceived need of the current economy, to computational participation, that is informed and full awareness of both the opportunities and constraints of co-creation as contextualised in the local environment.

6 Conclusion

Through our playful approach, we found that design thinking, when integrated with game-based learning, can initiate interest and engagement toward higher-order thinking. Through play, students at these rural schools were able to participate in the learning experience in a more positive attitude and demeanour. The cognitive engagement was present as the students explored the gamified lessons which were designed with challenges and rules that they needed to determine and solve. Design thinking is also an increasingly comprehensive approach deployed in education settings and using its elements as the foundation to the CreativeCulture model helped frame the learning experience coherently and cohesively.

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References

1. Chang, D.W., Morshidi Sirat, and Dzulkifli Abdul Razak. (2018). Education in Malaysia Towards a Developed Nation. Economics Working Paper. No.2018-4. [URL:https://www.iseas.edu.sg/images/pdf/ISEASEWP2018-4Wan.pdf](https://www.iseas.edu.sg/images/pdf/ISEASEWP2018-4Wan.pdf)
2. Ong, S.L.(2010) Assessment profile of Malaysia: high-stakes external examinations dominate, *Assessment in Education: Principles, Policy & Practice*, 17:1, 91-103, DOI: [10.1080/09695940903319752](https://doi.org/10.1080/09695940903319752)
3. Garside, C. (1996). Look who's talking: A comparison of lecture and group discussion teaching strategies in developing critical thinking skills, *Communication Education*, 45:3, 212-227, DOI: [10.1080/03634529609379050](https://doi.org/10.1080/03634529609379050)
4. Bateson, G. (1973). *Steps to an Ecology of Mind: Collected Essays in Anthropology, Psychiatry, Evolution and Epistemology*. Paladine.
5. Nørgård, R. T., Toft-Nielsen, C., & Whitton, N. (2017). Playful learning in higher education: developing a signature pedagogy. *International Journal of Play*, 6(3), 272-282.
6. Walsh, G., McMillan, D., & McGuinness, C. (Eds.). (2017). *Playful teaching and learning*. Sage.
7. Bateson, G. (1955). A theory of play and fantasy; a report on theoretical aspects of the project of study of the role of the paradoxes of abstraction in communication. *Psychiatric research reports*, (2), 39-51.
8. Parker-Rees, R. (2002). Protecting playfulness. In *Early education transformed* (pp. 77-88). Routledge.
9. Barab, S., Pettyjohn, P., Gresalfi, M., Volk, C., & Solomou, M. (2012). Game-based curriculum and transformational play: Designing to meaningfully positioning person, content, and context. *Computers & Education*, 58(1), 518-533.
10. Wanick Vieira, V. (2017). *A framework for cross-cultural advergame design: a comparison between Brazil and the UK* (Doctoral dissertation, University of Southampton).

11. Siti Masliah Rosliah binti Abdul Rashid. (2008). Peluang dan Cabaran Pendidikan Dalam Kalangan Masyarakat Luar Bandar: Satu Kajian Kes Isi Rumah Melayu Miskin in Jajahan Bachok, Kelantan. *Master's Dissertation*. Universiti Sains Malaysia.
12. Prensky, M. (2003). Digital game-based learning. *Computers in Entertainment (CIE)*, 1(1), 21-21.
13. De Freitas, S. (2006). Learning in immersive worlds: A review of game-based learning. JISC report for E-Learning. URL: https://www.webarchive.org.uk/wayback/archive/20140613220103/http://www.jisc.ac.uk/media/documents/programmes/elearninginnovation/gamingreport_v3.pdf
14. Whitton, N. (2009). *Learning with digital games: A practical guide to engaging students in higher education*. Routledge.
15. Squire, K. (2011). *Video Games and Learning: Teaching and Participatory Culture in the Digital Age. Technology, Education--Connections (the TEC Series)*. Teachers College Press. 1234 Amsterdam Avenue, New York, NY 10027.
16. Gee, J. P., & Hayes, E. (2012). Nurturing affinity spaces and game-based learning. *Games, learning, and society: Learning and meaning in the digital age*, 123, 1-40.
17. Kim, P., Buckner, E., Kim, H., Makany, T., Taleja, N., & Parikh, V. (2012). A comparative analysis of a game-based mobile learning model in low-socioeconomic communities of India. *International Journal of Educational Development*, 32(2), 329-340.
18. Leonard, J., Mitchell, M., Barnes-Johnson, J., Unertl, A., Outka-Hill, J., Robinson, R., & Hester-Croff, C. (2017). Preparing Teachers to Engage Rural Students in Computational Thinking Through Robotics, Game Design, and Culturally Responsive Teaching. *Journal of Teacher Education*, 0022487117732317.
19. Qian, M., & Clark, K. R. (2016). Game-based Learning and 21st-century skills: A review of recent research. *Computers in Human Behavior*, 63, 50-58.
20. Skilbeck, A. (2017). Dewey on Seriousness, Playfulness and the Role of the Teacher. *Education Sciences*, 7(1), 16.
21. Hamari, J., & Nousiainen, T. (2015, January). Why do teachers use game-based learning technologies? The role of individual and institutional ICT readiness. In *2015 48th Hawaii International Conference on System Sciences (HICSS)* (pp. 682-691). IEEE.
22. Pavlidis, G. P., & Markantonatou, S. (2018). Playful Education and Innovative Gamified Learning Approaches. In *Handbook of Research on Educational Design and Cloud Computing in Modern Classroom Settings* (pp. 321-341). IGI Global.
23. Park, J., & Wen, R. (2016). A comparative framework for culturally differentiated digital game-based learning. *International Journal of Comparative Education and Development*, 18(3), 138-149.
24. Burke, Q., O'Byrne, W. I., & Kafai, Y. B., (2016). Computational participation: Understanding coding as an extension of literacy instruction. *Journal of Adolescent & adult literacy*, 59(4), 371-375.