

Journal of Indigenous Research

Full Circle: Returning Native Research to the People

Volume 8
Issue 2020 March 2020

Article 9

September 2020

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Elizabeth LaPensee
Michigan State University, odamino@msu.edu

Christie Poitra
Native American Institute, Michigan State University, poitrach@msu.edu

Angela Kolonich
CREATE for STEM Institute, Michigan State University, gerberan@msu.edu

Estrella Torrez
Michigan State University, torrezjs@msu.edu

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Recommended Citation

LaPensee, Elizabeth; Poitra, Christie; Kolonich, Angela; and Torrez, Estrella (2020) "Generative Generations: Adapting Culturally Rooted Science Ideas to Video Game Design," *Journal of Indigenous Research*: Vol. 8 : Iss. 2020 , Article 9.

Available at: <https://digitalcommons.usu.edu/kicjir/vol8/iss2020/9>

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Cover Page Footnote

Acknowledgements Generative Generations was made possible thanks to Michigan State University's Science and Society @ State Interdisciplinary Seed Grant in partnership with the Indigenous Youth Empowerment Program.

Introduction

Generally, youth who play video games gravitate towards Science, Technology, Engineering, Arts, and Math (STEAM) education (Hosein, 2019). By engaging these youth in designing video games, they become developers rather than merely consumers (Salen, 2007; Sanford & Madill, 2007). Video game design can involve ideating how the game is played, what the environments look and feel like, who or what the player is, and what the player's motivation is. There are several projects that engage youth in game design as STEAM (Annetta et al. 2012; Games & Kane, 2011; Kafai & Burke, 2015; Earp, 2015; Fowler, 2016). Generative Generations is one such project, which uniquely aims to serve Indigenous youth by building in cultural responsiveness (Sheridan et al. 2013; Bang et al. 2013).

Generative Generations is a workshop kit to facilitate Indigenous youth in designing video games that include culturally rooted science ideas (e.g., medicinal plant knowledge and water teachings). The workshop kit centralizes paper prototyping game design ideas that can be applied to any form of game ranging from card games to board games to video games to mobile games to virtual reality games (Figure 1). Paper prototyping is an industry-standard approach to conceptualizing game design (Fullerton, 2014) that is accessible even with limited access to technology, which is the case for many Indigenous communities (Morris & Meinrath, 2009; Duarte, 2017). The kit layers in prompts to encourage youth to think about design choices that reflect Indigenous ways of knowing, meaning ontologies about the interconnectedness of Indigenous people, lands, animals, insects, plants, waters, stars, and rocks (Martin & Mirraboopa, 2003; Metallic, 2009).



Figure 1. Generative Generations Workshop Kit Prototype

The kit was tested in a pilot study that took place as part of the 2018 Indigenous Youth Empowerment Program (IYEP) week-long summer culture day camp. IYEP is a non-profit organization that serves urban Indigenous youth in Nkwejong (translating approximately to "Where the Rivers Meet" and referring to the Greater Lansing Area in Michigan). While the kits were found to be engaging and culturally relevant, resulting in unique game design ideas that integrated culturally rooted science ideas such as traditional medicinal knowledge, results showed that the urban Indigenous youth involved generally needed more support in expanding their knowledge of culturally rooted science ideas. Thus, future work involves iterating the kit to include deeper integration of culturally rooted science ideas rather than prompts before beginning game design.

Background

The development of the Generative Generations workshop kit involved collaboration across North America with Indigenous elders, community members, industry experts, Indigenous

science role models, caretakers, and youth through over ten years of game design workshops. The kit includes materials to paper prototype games with culturally rooted science ideas as an integration of Indigenous ways of knowing with STEAM. STEAM, an expansion of STEM, is the integration of science, technology, arts, and math in educational curricula (Watson & Watson, 2013). Game design workshops are STEAM in that they involve understanding and designing technology, determining art styles for games and actively creating conceptual prototypes or game assets using art skills, engineering game systems, and understanding and implementing math through instances such as spatial design and/or coding (Pollock et al., 2017). Generative Generations addresses the lack of overt integration of science in game design workshops by including Indigenous culturally rooted science ideas as prompts to inform game design ideas.

The kit further expands STEAM by integrating Indigenous ways of knowing, meaning the ways in which knowledge is generated in relation to cultural values, histories, and practices. Specifically, the kit focuses on culturally rooted science ideas, such as traditional ecological knowledge, blood memory (e.g. skills from ancestors being passed on to the player character through DNA), and physics concepts (e.g. player characters having powers to use sound as force) as prompts for Indigenous youth to generate game design. Game design relates a game's mechanics, which are the actions that can be taken in a game such as jumping, running, and smashing in the video game *Super Mario Bros.* (1986) or gifting, listening, and resisting in the Indigenous computer game *When Rivers Were Trails* (2019). Designing can also involve conveying the art style, sound, and story. Paper prototyping, which is the main activity facilitated by the workshop kit, is an approach to tangibly convey game design for any type of game. Youth can prototype card games and board games that are effectively playable as-is or develop a

concept for a video game, mobile game, virtual reality game, or other form of digital game that focuses on limited aspects of the design that can be played with non-digital materials.

Holistically, Generative Generations interweaves STEAM and Indigenous ways of knowing using game design as a pathway for Indigenous youth to relate to culturally rooted science ideas.

Related Work

Generative Generations is informed by the intersections of STEAM and Indigenous pedagogy through game design for Indigenous youth (LaPensée & Lewis, 2011). The workshop kit seeks to exemplify qualities from Indigenous pedagogy, which are engaging, hands-on, collaborative, and culturally relevant (Grande, 2015). It is also informed by work in Indigenous cultural science and technology education (Aikenhead, 1997; Bang & Medin, 2010); Mack et al., 2012), which has grown thanks to researchers including Megan Bang who have built up participatory design research (Bang & Vossoughi, 2016) as an approach to integrate Indigenous ways of knowing with STEAM experiences (Tzou et al., 2018; Barajas-López & Bang, 2018). The process for initially developing Generative Generations as a workshop kit, although informal and beyond the scope of this research report, was informed by this intergenerational process of involving community.

As Generative Generations is an Indigenous-led kit for game design workshops geared towards Indigenous youth, it aligns with the Skins video game development workshops (LaPensée & Lewis, 2011) as well as the Indigenous Matriarch 4 virtual reality workshops (Morin, 2019). However, the kits uniquely emphasize accessibility and can be used by communities with limited technology and Internet access. The materials specifically focus on Indigenous youth adapting culturally rooted science ideas to game design. Hands-on prototyping skills can be applied towards the future development of video games.

Community-Led Pilot Study

The pilot study was designed in collaboration with the Indigenous Youth Empowerment Program (IYEP) in order to ensure that it offered an engaging component to their annual summer camp. The IYEP hosted the pilot study over five-days with Indigenous youth ages 9-16 in their free 2018 summer camp situated within a curriculum centered on Anishinaabe culture, language, crafts, health, and technology. The workshop was integrated seamlessly throughout the schedule and offered in a repurposed classroom. Local elders and parents participated as teachers for the curricular portion, while university and high school students served as camp mentors. The game design workshop component reinforced their aim to establish long-term mentorship by involving Everardo Cuevas, a graduate student at Michigan State University who contributed writing to the Indigenous game *When Rivers Were Trails*, as a mentor. The game served as a model for youth as they prototyped their game design ideas, since the gameplay includes Indigenous ways of knowing concerning land, waters, medicinal plants, and animals.

During the pilot, Indigenous youth paper prototyped both board games as well as what they imagined would eventually be video games using materials including paper, grid paper, hex paper, cardboard, tape, wooden tokens, wooden pegs, sinew, beads, and felt. The kits purposefully include culturally relevant materials alongside industry standard materials to convey the equal importance of both in generating games. As they worked hands-on with their prototypes, they worked collaboratively in small groups (Figure 2) with the exception of one youth choosing to work independently.



Figure 2. Youth Prototyping During Pilot Study

Methodology

Generative Generations is community-based participatory research (Michell, 2009) situated within an Indigenous feminist methodology (Cannella et al., 2008; Ray, 2012; Goeman & Denetdale, 2009). Indigenous participants are not seen as individuals who need interventions, but rather as contributors who are seen as knowledgeable and who should be given opportunities to engage in self-expression (Smith, 2013). The workshop kit is an action-based contribution wherein the research involves a gift back to those involved. The pilot study centers the hope for iterating the kit to distribute more widely for free to Indigenous communities while acting in reciprocity with Indigenous youth.

Methods

Indigenous feminist methodology leverages methods with conversational and reciprocal qualities (Kovach, 2005). As such, data was generated from observations, written down by research team members during the workshop sessions; talking circles (Lavallée, 2009), where

youth took turns speaking about their experiences to the group while camp mentors and research team members wrote notes; and artifacts (Peppler & Kafai, 2007), which involved taking photos of the paper prototypes generated by youth. Youth were invited to take their prototypes home with them as well as take any remaining kit materials so that they could continue to design games on their own.

Observations and notes taken during talking circles were live-coded for emergent themes, meaning that patterns began to take shape as the workshop sessions were occurring (Baralt, 2012). The themes were generated independently by camp mentors and research team members, and then confirmed or reframed by the research team each day after the workshop sessions across the five days to ensure consistency in later analysis. After the workshop, all of the data was collected together, anonymized, and compared for patterns of various themes. This research report looks specifically at the use of culturally rooted science ideas in generated games.

Results

Indigenous youth who attended the workshop sessions integrated their own culturally rooted science ideas into game design ideas based on prompts which were shared on playing cards with the name of the science idea on the front of the card with a correlating symbol and a description of the science idea on the back of the card. These prompts included "land practices," "medicinal plant knowledge," "traditional food practices," "spacetime travel," and "water teachings" concepts in quantum physics. Prompts that were not utilized during this pilot included "blood memory." They integrated concepts from physics, math, engineering, and technology on their own as well as oceanography. Overall, the majority of games wove together multiple themes with a mix of STEAM and Indigenous culturally rooted science ideas (see Table 1).

Table 1.*Generated Games*

Group	Age Range	Gender Identity	Game Description	Themes
1	9-13	3 Females; 3 Males	<i>The Portal</i> is a game where you have to collect traditional medicines that gives you power to get to the other side of the portal.	Traditional Medicines; Physics
2	12-14	1 Female; 2 Males	<i>Tang</i> is a game where humans must develop food and traveling and weapon technologies for survival against an alien attack.	Traditional Medicines; Food Practices; Engineering; Technology
3	9-10	2 Males	<i>Riot Civilians</i> is a game where rebels develop food, traveling and weapon technologies while honing skills to move through the game.	Food Practices; Engineering; Technology
4	9-11	3 Females	<i>Fun Night</i> is a game where players find secret tunnels by solving problems.	Land Practices; Math

5	9	1 Male	<i>Balces's Basics</i> is a game where players must correctly answer the math problems to progress in the game.	Math
6	9-12	3 Females	<i>Crossing the Ocean</i> is a game about using a canoe to travel across the ocean—with the goal of making it to land. Players encounter animals and dangers as they cross the ocean.	Water Teachings; Oceanography

When looking closer at observations and talking circles rather than just the artifacts, findings showed that youth needed additional support in expanding their knowledge of culturally rooted science ideas. Since the Generative Generations pilot was run by Indigenous researchers and mentors who have experience in game design, youth were able to ask questions and engage in working through how to convey culturally rooted science ideas as game mechanics (Figure 3). However, the workshop kit cannot currently be widely disseminated in its current state since it requires iterations with more robust expressions of Indigenous ways of knowing that go beyond playing cards as prompts in order to be implemented beyond the core team involved in this research.



Figure 3. Traditional Medicinal Knowledge Themed Game

Conclusions and Future Work

Generative Generations shows promise as a workshop kit to facilitate Indigenous youth in adapting culturally rooted science ideas to game design ideas. Importantly, the foundation of these science ideas needs to be made stronger within the kit in order to be deployed beyond the camp mentors and research team who are directly involved in the pilot study and were present to clarify any questions from youth regarding the science ideas. In response, the team is currently seeking additional support to iterate the workshop kit with comics to tell visual stories that convey culturally rooted science ideas with hope for eventually sharing kits for free both to IYEP as well as any Indigenous community interested in running their own Generative Generations workshops.

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