Video Games and Aboriginal Learners: Spatial Cognition, Learning, and Game Design

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Author Note

This paper uses the following terms: Indigenous, Aboriginal, and First Nations. "Indigenous is a term used throughout the world to refer to the original inhabitants of the land. Aboriginal is a Canadian constitutional term that refers to First Nations, Métis and Inuit. First Nations refer to those who are formerly known in Canada as Native Indian." (Tanaka et al., 2007, p. 100)

Video Games and Aboriginal Learners: Spatial Cognition, Learning, and Game Design

The cover of a Canadian Teachers Federation article entitled *Beyond Shadows: First Nations, Metis and Inuit Student Success* (Toulouse, 2013) has a beautiful picture of Inuksuks (Appendix A), also spelled Inukshuk, by international balanced rock sculptor, painter and photographer, John Felicè Ceprano. This illustrates the art of balance and harmony – a cross-cultural and universal state that all demographics seek to achieve, especially with respect to education and student success in this increasingly networked and digital world. Tony Bates (2014) addresses the difficulty in achieving this balance for our Aboriginal students, and he cites an article published about the experiences of students in a rural first nation stating, "More support for and attention to the students' preferences for learning styles will lead to more successful…education programs in these communities" (n.p.). Bates goes on to say, "Digital technology now enables 'core' materials to be developed that can be adapted and/or supplemented to reflect differences between First Nations, especially if they are created as open educational resources…the problem is not that we don't know what to do; it's just that we don't do it" (2014, n.p.). The purpose of this paper will be to examine how we might improve the success of Aboriginal learners, by looking at their learning styles, with a particular focus on spatial cognition and cognitive training. A review of literature examining spatial cognition and the use of video games and digital technology will address the question: ***Can the use of video games in education enhance the learning and success of Aboriginal students?***

My Teaching Context

The question addressed in this paper arises from observations I have made while teaching (in brick-and-mortar classrooms at various grade levels, and as a DL teacher,

since 1999) in Terrace, B.C., Canada. Terrace is a small northern community of 11,310 people (Wikipedia, 2016) with a sizable First Nations population (according to Statistics Canada, listed between 12.9% in 2011 and 16% in 2006; however, Wikipedia (2016) cites the Aboriginal population as being 22.6% of Terrace's total population).

The Kitselas and Kitsumkalum are two Tsimshian communities located in the Terrace area.[1] Other First Nations communities surround Terrace, including the Nisga'a Nation (Appendix B), which consists of the Gitwinksihlkw, Gingolx, Gitlakdamix and Laxgalts'ap villages. Classroom interaction and discussion with students from these Indigenous communities, and dialogue with colleagues of various heritages, seems to reinforce that First Nations students "generally learn in ways characterized by factors of social/affective emphasis (affective factors deal with motivational processes), harmony, holistic perspectives, expressive creativity, and nonverbal communication" (Pewewardy, 2002). So what does this mean, and how can educators contribute to the success of First Nations students by teaching to their preferred learning styles?

Learning Styles of First Nations Students

Aboriginal individuals appear to display some characteristic learning styles, and a body of literature now exists in this regard (developed predominantly since 1980). However, it is important to begin the discussion of learning styles,[2] which refer to how students approach different tasks, and the way they perceive and assess information (Rasmussen et al., 2004, p.323), by outlining some characteristics of First Nations culture. Culture is felt to be central to First Nations education.

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[1] The Kitselas "People of the Kitselas Canyon" are located 16 Km east of Terrace, while the Kitsumkalum "The People of the Robin" are just west of Terrace, BC. (NorthBC EH.com, n.d.).

[2] Learning styles refer to a wide range of theories that aim to classify and account for differences in peoples' 'style' of learning. Theories often differ in their views, and some theories compete with each other, while others may be contested. (Wikipedia: Learning styles, 2016, n.p.)

A publication by H. Colleen Marchant (2009), a graduate student under the supervision of Dr. Lorna Williams (a professor at the University of Victoria, B.C., and a former teacher from northern B.C.), outlines a number of attributes important to Indigenous people. Marchant quotes a 2007 study by Saunders et al. which emphasizes the importance of respect:

> A number of concepts bridge most, if not all, Indigenous people. Respect for each other and nature, the understanding of community, and the need for authenticity or an authentic voice are common values… These authors cite the '3Rs' of First Nations culture (Appendix C): respect (for the individual and for differences), relevance (of the content to the learner and life), and reciprocative learning (the partnership of learning with and from each other). (p. 15)

Characteristics such as respect, inter-connectedness, allowing others to go first, cooperation, collective decision-making, "sharing, non-competitiveness, politeness, reluctance to speak out, present rather than future orientation, norms of non-interference, and flexible notions of time" (Marchant, 2009, p.16) are traits felt to be important for "harmony, unity and a basic oneness" (Marchant, 2009, p.16).

There are many ways one might categorize First Nations learning styles; however, the following classification by Cornel Pewewardy (2002) is a good summary of learning styles. This paper will focus on elements of Perceptual Strengths, although learning styles are often interrelated:

1. Field-Dependence/Field-Independence

2. Perceptual Strengths (Visual, Auditory, and Kinesthetic)

3. Reflectivity Versus Impulsivity

4. Classroom Management and Behavior

5. Role of the Family, Tribe, and Elders

6. Teacher/Pupil Relationships

7. Cooperation Versus Competition (p.10-11)

Pewewardy (2002) cautions it is important to not stereotype the learning styles of First Nations learners, because although patterns of learning may exist, students can differ dramatically within their given communities. In addition, students often have a mixture of learning styles. It is noted that factors such as degree of assimilation, spiritual beliefs, kinship patterns, values, economics, and levels of acculturation can contribute towards individual variation and difference. Worthly (1987), as cited in Pewewardy (2002), states that, "Individuals within a culture tend to have a common pattern of learning when members of their culture are compared to members of other cultures (p.5). Lev Vygotsky, whose work has become the foundation of much research in cognitive development leading to the Social Development Theory (McLeod, 2014), stresses the importance of social interaction in the development of cognition.[3] Vygotsky believes community plays a role in "making meaning" or "sense making", and that social learning leads to the co-construction of knowledge, which is felt to precede cognitive development. Furthermore, Vygotsky theorizes that cognitive development varies across cultures; a theory that is at odds with Piaget's view of cognitive development being universal across cultures (McLeod, 2014, para. 6). Pewewardy (2002) notes that, "In recent years, the research by cognitive neuroscientists on the cerebellum into brain processing, brain growth, and brain dominance has led educators to take another look at traditional instructional methods of

[3] Cognition includes information processing habits such as "perceiving, thinking, remembering, and problem-solving (Pewewardy, 2002, p. 5).

teaching" (p.1). He states, "American Indian/Native Alaska Natives have definite learning style tendencies such as strength in the visual modality and a preference for global, creative, and reflective styles of learning" (p.28).

Cognitive Patterns and Visual-Spatial Abilities of Aboriginal Individuals

The development of unique learning and cognitive patterns may be favoured by cultural and ecological characteristics of different societies. A study by Berry (1966) compared the cultural and ecological differences of two societies - the Temne (from Sierra Leone) and the Inuit (of Baffin Island) - and tested the visual-perceptual skills of these two groups. A Scottish reference group was also tested so data could be related to Western psychological findings; however, for the purpose of this discussion, focus will be on the Temne and Inuit. Berry's study (1996) found that due to the Temne and Inuit inhabiting very different geographic regions, where great differences existed within their visual environments, the visual-spatial abilities of the groups varied. For example, the Temne experienced a wealth of visual stimulation due to the rich, colourful vegetation, whereas the Inuit experienced uniform visual stimulation, a result of year round bleakness – i.e., a vast expanse of winter whiteness and a few short weeks of mostly grey-brown tones in the summer. Data from Berry's research (1996) revealed that the Inuit performed much higher on tests of visual discrimination and spatial skill. The Inuit were found to have well-developed visual-spatial abilities, presumably due to the demands of the Arctic environment offering only very minor visual cues. The bleakness of the Arctic, as noted by Rasmussen et al. (2004), means the Inuit "must be able to detect slight changes in the snow atmosphere. They also have to scan and remember visual-spatial information to navigate in their environment with very few landmarks" (p. 319). It is assumed that

individuals with strong visual-spatial abilities would be better suited to surviving the Arctic's 'monotonous' environment. Meyers (2015) feels visual-spatial skills "are essential as one learns how to interact with one's environment" (n.p., Appendix D).

Research by Judith Kleinfeld (1971) appears to support Berry's conclusions. Kleinfeld (1971) administered a visual memory test to 125 village Inuit children and 501 urban Caucasian children, and results found that the Inuit children demonstrated significantly higher visual memory levels. Kleinfeld (1971) addressed the development of visual memory from both the cultural and ecological standpoints. Contributors to the development of visual memory were noted to include: requirements of Arctic and urban ecology (i.e., colour, landmarks, spatial locations); socialization practices, including the hunting and child-rearing practices of the Inuit, which were said to contribute to the development of high visual-memory skills; and Inuit language in relation to the speaker's "attentiveness to and memory for visual forms and patterns" (p. 133). Kleinfeld (1971) also cited the work of Osborne and Gregor (1966) with regard to genetic factors: "Visual memory may be in part the result of natural selection. This type of perceptual skill has been found to have a high degree of heritability" (p.133). Furthermore, as cited by Rasmussen (2004), Kleinfeld observed from anecdotal evidence that the Inuit were able to "view maps and objects from various angles of rotation" (p. 319), much like one would see in a video game or 3D virtual environment. Kleinfeld also noted the Inuit were able to draw extremely detailed and accurate maps of land expanses, once again relating to the ecological environmental demands fostering enhanced spatial-perceptual development in some hunting groups (Rasmussen, 2004, p.319). Therefore, a number of studies appear to have similar conclusions on the cognitive patterns and heightened visual-spatial abilities

of Aboriginal individuals, as cited by Rasmussen (2004, p. 318-322) in a comprehensive review of the literature by Vernon (1966), Lombardi (1970), Garber (1968), Guillmet (1981), Dasen (1975), and Kaerins (1981, 1986), and in addition to studies already noted.

Spatial Cognition: A closer look

Cognition is the mental process of gaining knowledge and understanding, by way of thought, experience, and the senses. As stated by Spence & Feng (2010), "Human cognition depends on a number of distinct mental components, with spatial, verbal, and analytic capacities being the most important" (p.94). Thurstone (1938), as cited by Spence & Feng (2010), was one of the first to recognize that "spatial cognition is an independent component of cognition, distinct from verbal and analytic abilities" (p.94).

Spatial cognition refers to how one acquires, processes, and revises knowledge about spatial environments. Earlier definitions of spatial cognition considered the ability to visualize an object and to manipulate it in order to match another object (i.e., by twisting, turning, or rotating it); however, spatial cognition is now considered to include large-scale spatial behaviours including navigation and wayfinding.[4] Spatial cognition is a precursor to action, as it allows for the mental patterns associated with the positions and relationships among objects. Without the necessary spatial information, motor behaviour would be impossible.

Video Games and Spatial Cognition

Although video games have become a ubiquitous part of our lives, with 97% of all children and adolescents in the United States reported to play for at least an hour per day,

[4] Finding one's way, "means the navigator can successfully move in the space from his present location to a destination, even if the destination is imprecisely known. Three criteria determine the navigability: first, whether the navigator can discover or infer his present location; second, whether a route can be found; and third, how well the navigator can accumulate wayfinding experience in the space." (Foltz,1998, n.p.)

most of the current research addresses the possible negative effects of playing video games, as opposed to any benefits that may exist (Granic, Lobel, & Engels, 2014, p.66). This might be due to the media's influence (usually a result of tragic news stories) on the funding of research to examine the pros or cons of playing video games. Most research on 'gaming' has focused on the potential negative effects such as addiction, aggression, and depression. It is only in the last five years that research has begun to document the positive effects of playing video games, and to date little study has been done on the mental health benefits of games (Granic et al., 2014, p.66).

Granic et al. (2014) divide the positive benefits of gaming into four main domains: cognitive (i.e., attention), emotional (i.e., mood management), motivational (i.e., resilience in the face of failure), and social (i.e., prosocial behaviour). This paper will only address the cognitive benefits of gaming, particularly the benefits derived through playing "action" games. These are felt to be a result of the visually rich three-dimensional spaces, the split-second decision-making required of players, and the unpredictable changes presented within the gaming environment. It has been documented that the benefits from these games last over an extended period of time (Gee, 2013; Spence & Feng, 2010) and that spatial skills derived from gaming can be transferred to other tasks in the real-world context (Granic et al., 2014; Trybus, n.d.). Moreover, spatial skills have been shown to predict achievement in science, technology, engineering, and mathematics (STEM) (Terrell, 2007).

Spence & Feng (2010) reviewed studies on the ability of video games to modify processes in spatial cognition, and they found “several studies have shown that playing action games induces changes in a number of sensory, perceptual, and attentional abilities

that are important for many tasks in spatial cognition" (p. 92). It should be noted that although Spence & Feng (2010) researched spatial abilities, which are involved in many areas of cognition, video games were found to also influence "verbal and analytic processes beyond the domain of spatial cognition" (p.92). However, not all video games affected cognitive processes equally, and only certain genres affected spatial cognition. Of those that did (for example the action, driving, maze, and puzzle genres), data seemed to suggest that the action games had the greatest positive consequences on spatial cognition, as illustrated by Appendix E (Munger, 2007; Spence & Feng, 2010). Although the maze and puzzle games required players to problem-solve using spatial skills, they did not typically require the speed or quick thinking needed by action or driving games (a driving game such as piloting an aircraft or driving a tank is usually less demanding than a typical action game, despite requiring similar cognitive capacities).

Although the most prevalent action games to date are the first-person shooter (FPS) games, there appears to be a growing movement to encourage game designers to build games that have the same basic characteristics as FPS games, without the characteristic violence. Some feel FPS games encourage aggressive behaviour or risk-taking; however, studies seem to suggest that the positive consequences may outweigh the negative (Ferguson, 2007; Granic et al., 2014; Spence & Feng, 2010). Fergson (2007) stated, "Current analysis did not support the conclusion that violent video game playing leads to aggressive behaviour. However, violent video game playing was associated with higher visuospatial cognition" (p.309). From an educational standpoint, it is this cognitive aspect that makes action video games so intriguing for their potential use in teaching (assuming appropriate games are found that do not have the characteristic violence).

Processes that Support Spatial Cognition

Video games can positively affect the sensory and perceptual processes necessary for spatial cognition, as games engage and stimulate a range of sensory, perceptual, and cognitive functions. Spence & Feng (2010) note that:

> Video games seem to have a unique advantage in improving low-level functions such as spatial selective attention (Feng et al., 2007; Green & Bavelier, 2003), spatial perceptual resolution (Green & Bavelier, 2007), and contrast sensitivity (Li, Polat, Makous, & Bavelier, 2009), in addition to more complex spatial skills such as mental rotation (Feng et al., 2007). Because fundamental sensory, perceptual, and cognitive skills serve as the building blocks for higher-level cognition, the ability of action games to improve basic processes has made them attractive candidates for further experimentation. (p. 95)

Li et al. (2009) have shown that video game playing and associated brain plasticity can bring about performance improvements in various aspects of vision, such as contrast sensitivity function (CSF) required for object recognition and spatial attention. Furthermore, attentional processes that capture visual events involving abrupt change (or ‘attentional capture’) - where the brain rapidly analyzes events to discern when decision-making, eye movements, and motor action are required - often involve prior knowledge, working and long-term memory, and executive control. Hence, improved visuomotor coordination results from playing video games that incorporate these types of visual events with the need for fine motor control. In summary, Spence & Feng (2010) state:

> More than a century of experimentation in psychology has shown that many higher level cognitive processes can be modified by training (Bourne,

> Dominowski, & Loftus, 1979); therefore, it is reasonable to suppose that the practice afforded by playing video games may also produce changes in basic perceptual and attentional processes because they are influenced by higher level cognitive processing. (p. 96)

Mechanisms of Learning

The effectiveness of video games in achieving improved cognitive patterns and visual-spatial abilities depends on the choice of game and the task itself. For example, not all games improve basic capacities, because not all games improve basic spatial skills. Also, a game may improve certain skills such as mental rotation tasks (i.e., Tetris); however, perceptual processes such as spatial selective attention or multiple object tracking may not be improved. “Playing action games, on the other hand, does result in generalization …and the learning is long lasting” (Spence & Feng, 2010, p. 99). Tasks requiring higher level cognitive processing demonstrate transfer of learning, as opposed to specific learning which is more representative of lower level cognitive processing. Cognitive training, moreover, has been demonstrated to have greatest effect when it occurs during early development, as neural plasticity is greatest during this time. Wass (2015) concludes, “Across a number of populations, there is correlational evidence suggesting that early emerging deficits in attentional control and working memory may be important in mediating later-emerging deficits in other areas” (p.2). Thus, if a child is able to regulate their attention to environmental events or stimuli, they are then free to direct their attention to other informational-rich areas for learning. In addition, Wass (2015) states, “Attentional markers in the visual and auditory modality correlated longitudinally with later assessments of intellectual abilities and classroom behaviour” (p.4). Therefore,

perhaps cognitive training, through the use of video games, could help to prepare students for future learning by developing their attentional control, and thus improving their working memory (Appendix F) and receptivity to new learning materials.

Video Game Principles

James Paul Gee (cognitive scientist, gamer, and professor at Arizona State University), in his video entitled "*Principles of Gaming*", speaks about how good video games can create 'good' effective learning. Gee (2013) states, "Games teach people problems and how to become good learners". He discusses a set of principles he has derived as good learning principles used by games to "hook people on learning and engage them for the long haul" (Gee, 2013, n.p.). Gee's video outlines thirteen principles, but Gee actually derives thirty-six principles from his study of learning that occurs as game players encounter and master new serious games – these are outlined in his book entitled, *What Video Games Have to Teach Us about Learning and Literacy*. Gee (2013) comments that good games encourage learners to try new things "where the cost of failure is low" (n.p.); the learner may even become a new type of learner. Thus, serious games should allow learners to solve problems in different ways. As Gee states, there are different types of players and different types of learners, so if there isn't a way to customize the experience to an individual's learning style, it lowers the learner's sense of agency – leaners need to feel what they do matters.

Gee summarizes in *Principle 31: Cultural Models about Learning Principle* that learning and game design should occur in "a way that learners come to think consciously and reflectively about their cultural models about learning and themselves as learners, without denigration of their identities, abilities, or social affiliations, and juxtapose them

to new models of learning and themselves as learners" (GMU, n.d., n.p.).[5] For this reason, Gee's *customization principle* is crucial. Customization allows players/learners to become integrally involved in the creation of their learning environment and how they learn, so if the player chooses, game play may represent their "norm" or preferred learning style. Thoughtfully designed games that offer ample opportunity for customization are perhaps the ideal learning environment for culturally responsive learning. One should keep in mind that humans create games; therefore, game designers' biases and cultural or societal beliefs can be subtly embedded within the code of the game (i.e., within the images, movements, and other nuances). It is critical that resources used for learning (i.e., games, or other tools and technologies) are carefully scrutinized and analyzed for suitability and efficacy. Furthermore, for games to truly incorporate and effectively demonstrate Gee's *Principles of Gaming*, it is important that we listen to and act upon Bates' (2014) appeal for "more support for and attention to the students' preferences for learning styles" (n.p.).

Conclusions and Future Study

The studies cited in this paper appear to offer sound reasons as to why educators should consider the use of appropriately selected video games to aid in the development of the sensory, perceptual, and cognitive functions of learners. Perhaps well-selected video games that align with some of the learning styles (and cultural norms) of First Nations students (i.e., particularly their perceptual strengths) might prepare students for future learning and success. After all, since the visual working memory and spatial attention are closely interrelated, and since information enters the long-term memory via the working memory process, would it not seem reasonable to improve the functioning of

[5] It should be noted that Gee (2014) defines a *cultural model* as "images, story lines, principles, or metaphors that capture what a particular group finds "normal" or "typical" in regard to a given phenomenon"(p. 142).

one's working and long-term memory via video game play? Furthermore, games and storytelling are an inherent part of First Nations culture and history, so could video games be a good fit for learning? This potential form of social learning (action games often involve a social and collaborative element or option with game play), as Lev Vygotsky theorized, may be an important (and highly underutilized) precursor for cognitive development (McLeod, 2014).

Granic et al. (2014) have put out a call to intervention researchers and practitioners to test the positive uses of video games (p. 66). More research, and attention to this body of research, may spur on the development of purposefully designed video games for use in educational settings. As Tanaka et al. (2007) cite, a practicing teacher stated (when reflecting upon methods of First Nations teaching and learning), "It was scary, and it would be a while until I would see that it was actually liberation. To me, this was a completely new approach to learning and teaching" (p. 102). Therefore, perhaps we need to liberate any shackles that currently prevent our exploration and discovery of new ways of teaching and learning. To better meet the needs of our First Nations learners, and in fact the needs of all learners, we need to incorporate current research and understanding of how and where learning is done. We need to examine the possibilities and affordances offered through the use of video games and virtual technologies, and we need to thoughtfully and deliberately integrate theses tools into our teaching practice. We need to ask ourselves: Could Aboriginal learners experience greater success if we as educators developed a better understanding of 1) cognition (and in particular visual-spatial cognition and brain-based learning), 2) cultural learning styles and preferences, and 3) video game design principles? Literature appears to indicate the answer might be a resounding… yes.

References

Bates, T. (2014, February 25). Research on Distance Education for First Nations/aboriginals, from IRRODL, Vol. 15, No. 1 [Blog post]. Retrieved March 25, 2016, from http://www.tonybates.ca/2014/02/25/research-on-distance-education-for-first-nationsaboriginals-from-irrodl-vol-15-no-1/

Berry, J.W. (1966). Temne and Eskimo Perceptual Skills. *International Journal of Psychology, 1:3,* 207-229. doi:10.1080/00207596608247156

Eide, B. & F. (2007, February 28) Normal developmental increases in visual spatial memory [Blog post]. *Eide Neurolearning Blog.* Retrieved April 11, 2016, from http://eideneurolearningblog.blogspot.ca/2007_02_01_archive.html

Ferguson, C. J. (2007). The good, the bad and the ugly: A meta-analytic review of positive and negative effects of violent video games. *Psychiatric Quarterly, 78*(4), 309-316. doi 10.1007/s11126-007-9056-9 Retrieved from https://www.researchgate.net/profile/Christopher_Ferguson/publication/5929680_The_good_the_bad_and_the_ugly_A_meta-analytic_review_of_positive_and_negative_effects_of_violent_video_games/links/00463530412b7600cb000000.pdf

Foltz, M. A. (1998). Designing Navigable Information Spaces: 5. Design Principles for Wayfinding [Online thesis publication]. Retrieved April 7, 2016, from http://www.ai.mit.edu/projects/infoarch/publications/mfoltz-thesis/node8.html

Gee, J. P. (2013, November 13). "*Jim Gee Principles on Gaming*" [Video]. Retrieved March 14, 2016, from https://youtu.be/4aQAgAjTozk

Gee, J. P. (2014). *What video games have to teach us about learning and literacy*. Macmillan. Available from http://www.amazon.ca/dp/B00OFL6RDE/ref=pe_386430_189886490_TE_DP

GMU (n.d.). Learning Principles. Retrieved March 19, 2016, from http://mason.gmu.edu/~lsmithg/jamespaulgee2print.html Drawn from Gee, J. P. (2003). *What video games have to teach us about literacy and learning*. New York: Palgraw Macmillan.

Granic, I., Lobel, A., & Engels, R. C. (2014). The benefits of playing video games. *American Psychologist, 69* (1), 66. Retrieved from https://www.apa.org/pubs/journals/releases/amp-a0034857.pdf

Kleinfeld, J. (1971). Visual memory in village Eskimo and urban Caucasian children. *Arctic*, 132-138. Retrieved from http://arctic.journalhosting.ucalgary.ca/arctic/index.php/arctic/article/viewFile/3123/3099

Li, R., Polat, U., Makous, W., & Bavelier, D. (2009). Enhancing the contrast sensitivity function through action video game training. *Nature Neuroscience, 12*(5), 549-551. doi:10.1038/nn.2296

Marchant, H. C. (2009). Indigenous ways of learning, being and teaching: implications for new teachers to First Nations schools. Retrieved from https://dspace.library.uvic.ca/bitstream/handle/1828/1929/CMarchant2009h.pdf?sequence=3&isAllowed=y

McLeod, S. A. (2014). Lev Vygotsky [Blog post]. Retrieved from http://www.simplypsychology.org/vygotsky.html

Meyers, R. (2015, April 14). Toys that help children develop spatial skills, creativity, and social skills [Blog post]. *Child Development Institute.* Retrieved April 10, 2016, from http://childdevelopmentinfo.com/child-activities/toys-that-help-children-develop-spatial-skills-creativity-and-social-skills/

Munger, D. (2007, October 8). Video games may reduce gender gap in spatial ability [Blog post]. *Cognitive Daily.* Retrieved April 10, 2016, from http://scienceblogs.com/cognitivedaily/2007/10/08/video-games-may-reduce-gender/

NorthBC EH.com. (n.d.). Kitselas, Kitsumkalum, Nisga'a First Nation People [Website]. Retrieved March 31, 2016, from http://www.northbceh.com/terrace/firstnations.htm

Pewewardy, C. (2002). Learning styles of American Indian/Alaska Native students: A review of the literature and implications for practice. *Journal of American Indian Education*, *41*(3), 22-56. Retrieved from https://www.tru.ca/__shared/assets/Pewewardy_2002_Learning_styles_Aboriginal23616.pdf

Rasmussen, C., Baydala, L., & Sherman, J. (2004). Learning patterns and education of Aboriginal children: A review of the literature. *The Canadian journal of Native studies*, *24*(2), 317-342.

Retrieved from http://www.afn.ca/uploads/files/education2/learningpatterns.pdf

Rasmussen, C., Horne, K., & Witol, A. (2006). Neurobehavioral functioning in children

with fetal alcohol spectrum disorder. *Child Neuropsychology*, *12*(6), 453-468. Available from: http://www.tandfonline.com/doi/abs/10.1080/09297040600646854

Spence, I., & Feng, J. (2010). Video games and spatial cognition. *Review of General Psychology*, *14*(2), 92. Retrieved from http://jtoomim.org/brain-training/video%20games%20and%20spatial%20cognition.pdf

Statistics Canada. (2011). Aboriginal Peoples in Canada: First Nations People, Métis and Inuit. Retrieved from https://www12.statcan.gc.ca/nhs-enm/2011/as-sa/99-011-x/99-011-x2011001-eng.cfm

Tanaka, M., Williams, L., Benoit, Y. J., Duggan, R. K., Moir, L., & Scarrow, J. C. (2007). Transforming pedagogies: pre-service reflections on learning and teaching in an Indigenous world. *Teacher development*, *11*(1), 99-109. Available from http://dx.doi.org/10.1080/13664530701194728

Terrell, N. (2007). STEM occupations: High-tech jobs for a high-tech economy. *Occupational Outlook Quarterly*, *51*(1), 26.

Toulouse, P. R. (2013). *Beyond shadows: First Nations, Metis and Inuit student success*. Retrieved from https://www.ctf-fce.ca/Research-Library/BeyondShadows_EN_Web.pdf

Trybus, J. (n.d.). Game-Based Learning: What it is, Why it Works, and Where it's Going. *New Media Institute.* Retrieved March, 9, 2016, from http://www.newmedia.org/game-based-learning--what-it-is-why-it-works-and-where-its-going.html

Wass, S. V. (2015). Applying cognitive training to target executive functions during early development. *Child Neuropsychology*, *21*(2), 150-166. Retrieved from http://www.mrc-cbu.cam.ac.uk/wp-content/uploads/2014/04/Wass-2014-Child-Neuropsych.pdf

Wikipedia. (2016, February 19). Learning styles. Retrieved April 5, 2016, from https://en.wikipedia.org/wiki/Learning_styles

Wikipedia. (2015). Terrace, British Columbia. Retrieved March 31, 2016, from https://en.wikipedia.org/wiki/Terrace,_British_Columbia

Appendix A

Inuksuks: The Art of Balance and Harmony

Designed by international balanced rock sculptor, painter and photographer, John Felicè Ceprano (Toulouse, 2013).

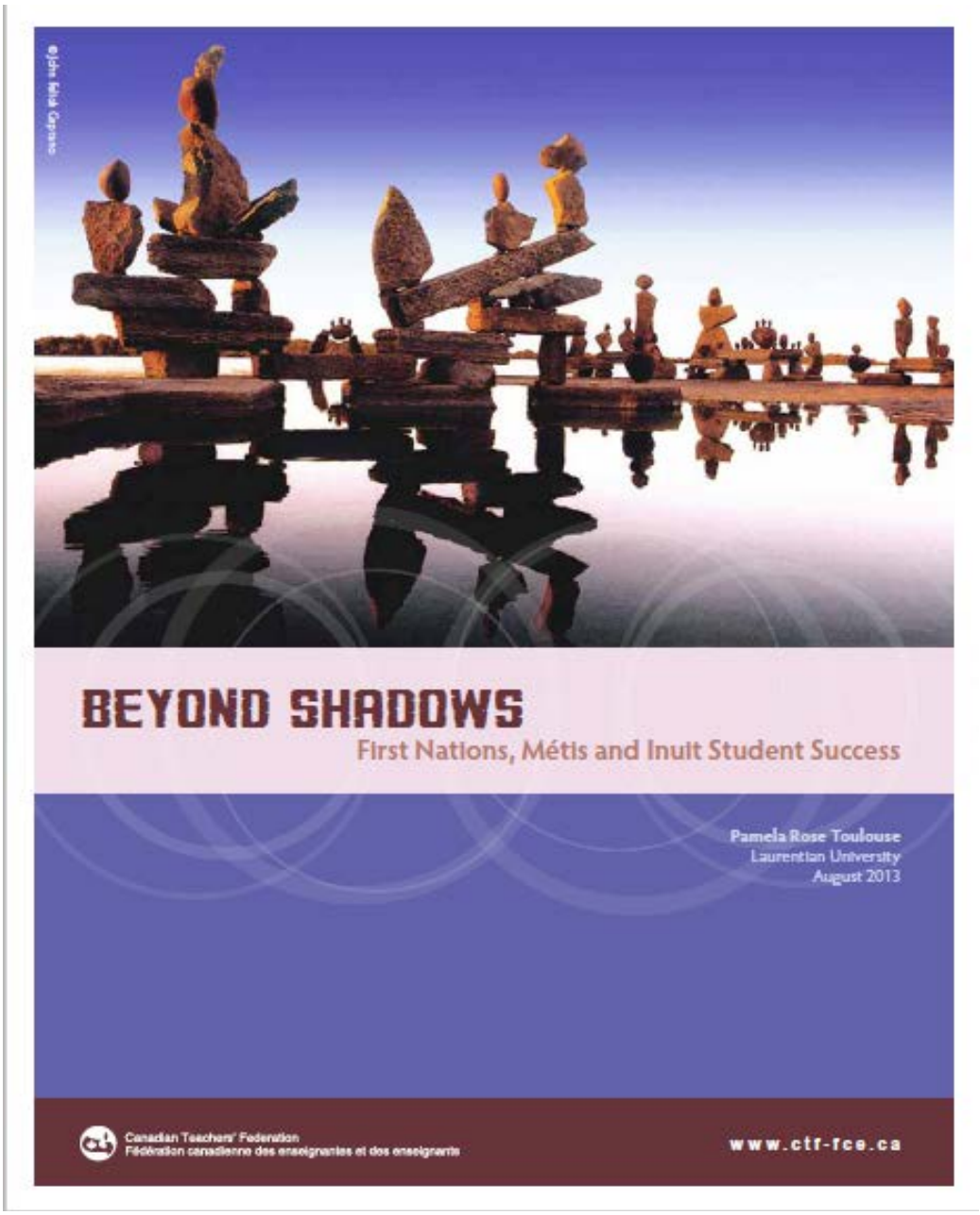
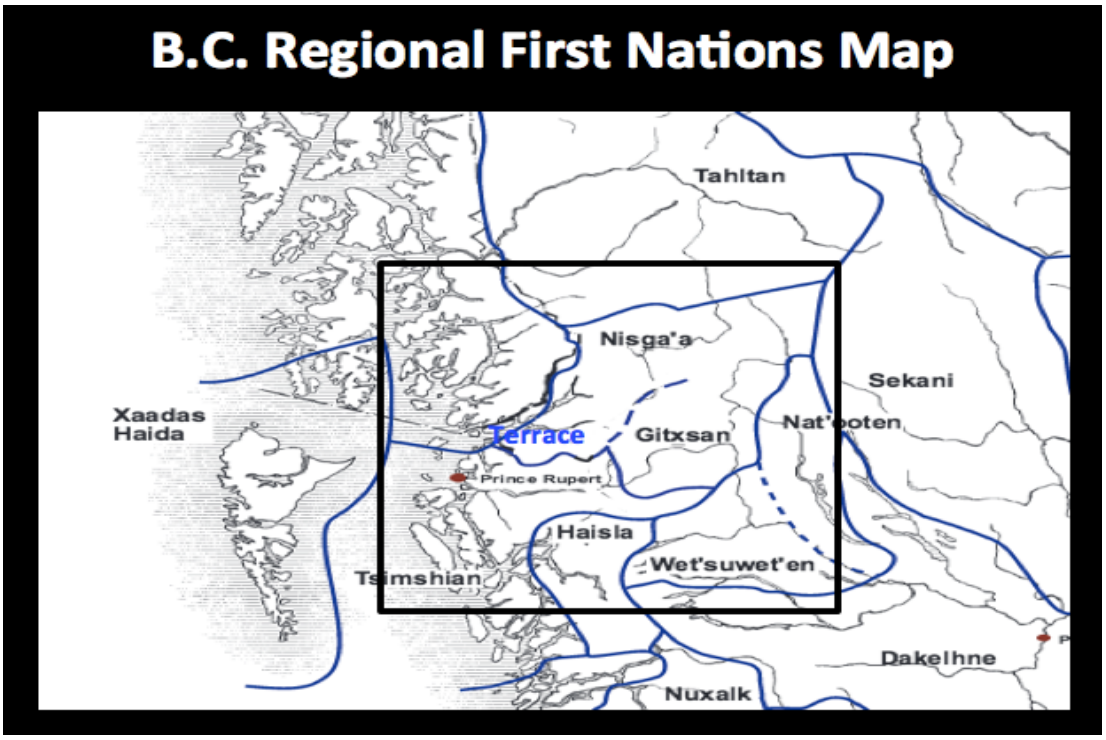


Image Source: Toulouse, P. R. (2013). *Beyond shadows: First Nations, Metis and Inuit student success*. Retrieved from https://www.ctf-fce.ca/Research-Library/BeyondShadows_EN_Web.pdf

Appendix B

Teaching in Terrace, B.C. - A Small Northern Community



Map Source: Government of Canada. (n.d.). Indigenous and Northern Affairs Canada [Website]. Retrieved April 11, 2016, from https://www.aadnc-aandc.gc.ca/DAM/DAM-INTER-BC/STAGING/texte-text/fnmp_1100100021018_eng.pdf Drawn from UBC Museum of Anthropology.

Appendix C

The 3R's Of First Nations Culture (Marchant, 2009)

Respect (for individuals & differences)

Relevance (of curriculum to the learner)

Reciprocative learning (the partnership of learning with and from each other)

Appendix D

Visual-Spatial Skills and our Environment

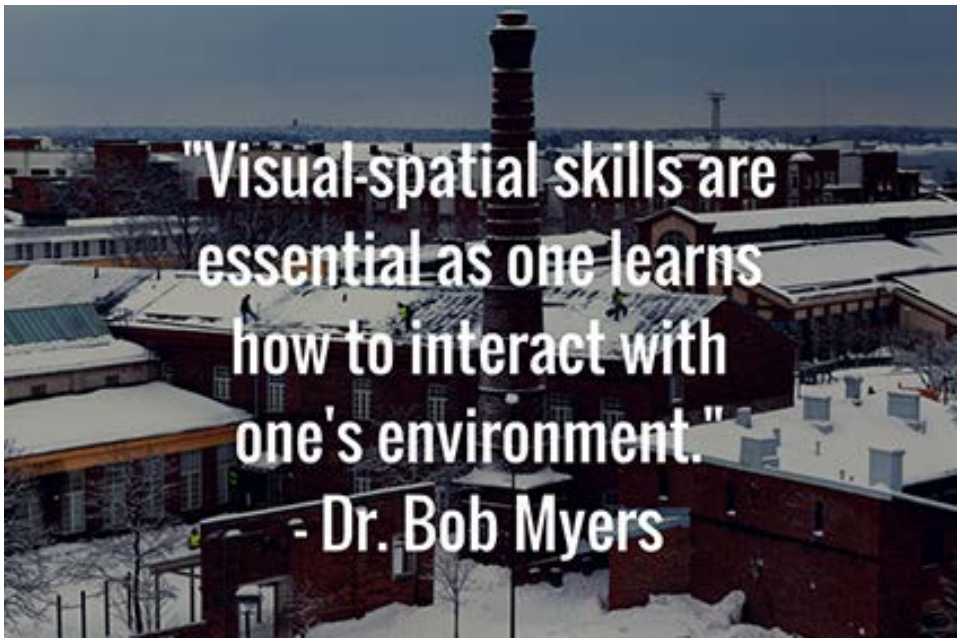


Image Source (above): Meyers, R. (2015). Retrieved April 10, 2016, from http://childdevelopmentinfo.com/child-activities/toys-that-help-children-develop-spatial-skills-creativity-and-social-skills/

Photograph of Prince Rupert Harbour, taken by Fenella Olynick

Appendix E

Video Games and Spatial Cognition

The spatial attention ability of video game players appears to be more advanced than that of non-video game players. Meanwhile, action video game training appears to produce better results on spatial attention than non-action video game training (Munger, 2007).

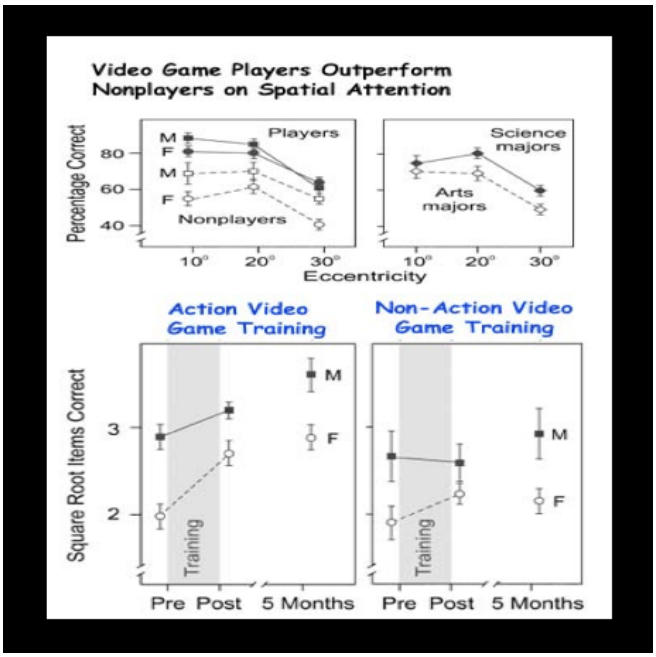


Image Source (above): Munger, D. (2007, October 8). Retrieved April 10, 2016, from http://scienceblogs.com/cognitivedaily/2007/10/08/video-games-may-reduce-gender/

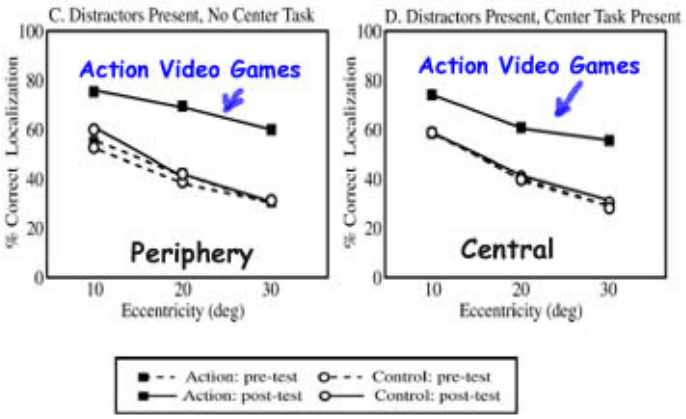


Image source (above): Eide, B. & F. (2007, February 28). Retrieved April 11, 2016, from http://eideneurolearningblog.blogspot.ca/2007_02_01_archive.html

Appendix F

Cognition, Working Memory and Attentional Control

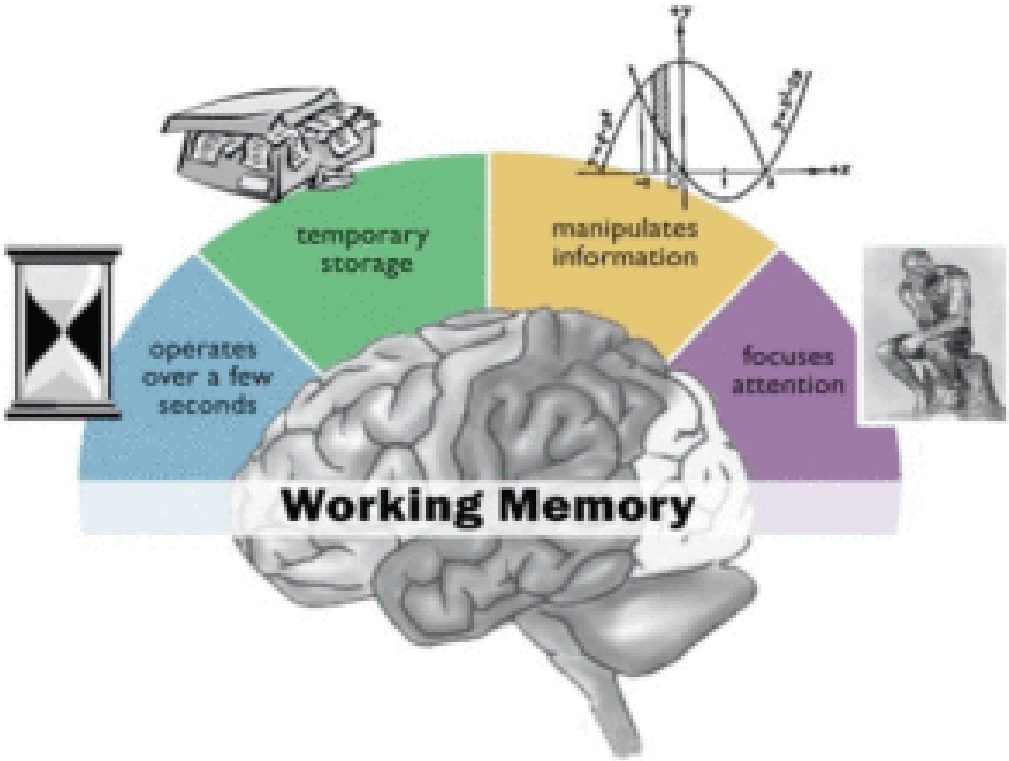


Image Source: Collmer, K.J. (2014, June 11). Visual Perceptual Skills: The Keys to Learning – Part 3 [Blog post]. Retrieved April 7, 2016, from http://blog.handwritingwithkatherine.com/visual-perceptual-skills-keys-learning-part-3/