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Gaming geography: Educational games and literacy development in the Grade 4 classroom

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Abstract

This paper outlines a case study conducted in two public schools in the greater Toronto area as a complementary component of a multisite experimental study exploring educational game development as a learning activity for motivating and engaging students in curriculum-related literacy activities[1] (Owston et al., 2007). Researchers studied children creating and playing four online board games based on grade 4 geography content, viz., *Tic-tac-toe, Trivial Pursuit, Snakes and Ladders,* and *Mother Goose*. The schools shared similar positive orientations to technologically focused learning and good technological resources, but they had different institutional histories of implementing computers in curricular learning. Technological equipment was approached, accessed and utilized quite differently in each class, affecting pedagogical practices and learning experiences. Though improvements to traditional literacy learning were found to be limited to improved logical sentence structure (Owston et al., 2007), game development did allow students to build digital literacy skills, including computer literacy and typing skills. Moreover, the project enabled participating teachers to think about profitably incorporating online board game production in broad-based curricular learning.

Résumé

Cet article présente une étude de cas menée dans deux écoles publiques de la grande région de Toronto en complément d'une étude expérimentale multisite visant à explorer la conception de jeux éducatifs en tant qu'activité d'apprentissage pour stimuler la motivation et l'engagement des élèves dans des activités de lecture et d'écriture liées au curriculum (Owston et al., 2007). Les chercheurs ont étudié les enfants lors de la création puis de l'utilisation de quatre jeux de plateau en ligne axés sur la matière de 4e année en géographie. Les élèves ont réalisé une version des jeux de Tic-Tac-Toe, de Quelques arpents de pièges, de Serpents et échelles et de Ma mère l'Oie. Les écoles partageaient les mêmes orientations positives en faveur de l'apprentissage axé sur la technologie et l'utilisation de bonnes ressources technologiques, mais elles différaient quant à leurs

antécédents institutionnels de mise en œuvre de l'utilisation des ordinateurs dans l'apprentissage du curriculum. L'approche adoptée, l'accès à l'équipement technologique ainsi que son utilisation variaient de manière significative selon les classes, ce qui a influencé les pratiques pédagogiques et les expériences d'apprentissage. Malgré le fait que les améliorations observées par rapport à l'apprentissage de la lecture et de l'écriture au moyen de méthodes traditionnelles se soient limitées à l'amélioration des structures de phrase logiques (Owston et al., 2007), la création de jeux a permis aux élèves d'acquérir des compétences en littératie numérique, y compris des connaissances en informatique et en dactylographie. En outre, le projet a permis aux enseignants participants de réfléchir à la possibilité d'intégrer de manière profitable la création de jeux de plateau en ligne au sein de l'apprentissage du curriculum en général.

Introduction

All children in schools today are 'digital natives', a term Prensky (2001) has popularized to describe children born into the post-industrial "information age" (Castells, 2000) whose social literacies naturally include a variety of electronic media. The literacy practices these children are learning at school increasingly diverge from their social and cultural practices (Lankshear & Knobel, 2006), and, crucially, future social, educational and professional communication needs. Although a rethinking of the literacy skills and practices required for full social and economic participation in the 21st century is beginning to be realized in literacy curricula in Ontario, mandatory provincial assessment and quotidian school practices continue to emphasize traditional literacy practices, such as the focus on page over screen as the predominant site of literacy consumption and production, and, prioritizing handwriting over typing skills.

For over a decade, prominent educational researchers have called for the revision of traditional pen-and-paper curricula to include multiple media for the representation, production, and dissemination of knowledge (Coiro, Lankshear, Knobel & Leu., 2008; Cope & Kalantzis, 2000; Gee, 2004; Kellner, 2004; Kress, 2003; Lankshear & Knobel, 2006; New London Group, 1996). Kellner (2004) contends that schools must be the primary agents of change in revising literacy curricula to better prepare students as competitive and responsible citizens in the new millennium.

New media have invited an extensive range of literacy practices that are growing in sophistication with Web 2.0 interactive possibilities. Indeed the cultural reach of the digital world now includes ontologies such as Second Life (http://secondlife.com/) in which people engage in a variety of social pursuits in parallel social institutions, from schools to gambling casinos, using avatars. As the gap between social and school literacy worlds widens, it is critical that teachers, researchers and educational policy makers work towards revitalizing formal education towards social relevance.

This article describes the findings of a case study of two Grade 4 classes who were trialing an experimental geography unit pedagogically based on online interactive board game creation and play. The case study was conducted to gain a nuanced understanding of the implementation and use of online board game development in curricular learning to facilitate literacy engagement and advancement. The qualitative inquiry followed the progress of two experimental Grade 4 classes as students researched and developed curriculum-based questions that they programmed into electronic versions of four board games, viz., *Tic-tac-toe, Trivial Pursuit, Snakes and Ladders*, and *Mother Goose,* using a game shell accessed online (http://www.savie.qc.ca/carrefourjeux2/). The game

development activities focused on question development in the Grade 4 geography unit, *Regions of Canada*, which teachers had described as "dry" material to teach. Teachers followed a detailed unit plan that included enrichment materials and game development to guide students through their board game development.

Gaming, literacy and learning

Computer games offer a culturally familiar medium to young learners, and present a novel and engaging means of bringing contemporary digital literacies into the curriculum. Prominent theorists argue that digital games provide immersive contexts motivating players to engage in a wide variety of activities that stimulate situated literacy learning (Beavis, 1997; Gee, 2003; Johnson, 2005; Mitchell & Savill-Smith, 2004; Prensky, 2006; Shaffer, Squire, Halverson & Gee, 2005). Digital game play fosters active engagement, motivation, and high levels of persistence in game play (Beavis, 2002; de Castell & Jenson, 2003; Facer et al., 2004; Garris, Ahlers & Driskell, 2002; Johnson, 2005). New digital environments, particularly game sites, combine traditional textual reading and writing with new literacies that pertain to accessing and evaluating information, constructing complex narratives, decision-making, and navigating rich multimedia environments (Beavis, 2002; Lotherington, 2003; Squire, 2008). Playing and (especially) developing online games invites students to access and engage with digital media and explore them, both independently and cooperatively. This exploration fosters the emergence and development of digital metaliteracies—skills that include navigating and 'reading' digital environments, as well as developing an understanding of the digitally-connected audience, and searching for information online (Lotherington, 2003).

The growing gap between the increasing sophistication and attractiveness of commercial gaming and the relatively static practices of school-based learning has led scholars to challenge the current state of technology use in schools (Squire, Giovanetto, Devane & Durga, 2005). Researchers have noted that the social aspect of collaborative or competitive game play fosters learning through team-playing (Mitchell & Savill-Smith, 2004) and group problem-solving (Kiili, 2007), and offers opportunities for players to cooperate not only within the game, but also within the larger community of game players through websites and online forums (Shaffer et al., 2005).

A particular emphasis in this study was placed on educational game design as an instructional activity. Kafai (2006) points out that despite a growing attention to using gaming in schools there is still a dearth of research on the educational significance of game design by students. In a project involving Grade 5-6 students in creating computer games for younger kids using the Logo programming environment, Kafai, Carter Ching, and Marshall (1997) focused on the development of scientific knowledge through game development. Their study showed that computer game development can serve as a productive platform for both learning about technology, and learning content with technology. But their project also revealed areas where students required continuing support: creating challenging multimedia content, finding ways to integrate learning about content and learning about programming, and creating habits of good game design.

In another study, Eow, Ali, Mahmud and Baki (2010) invited Grade 7 Malaysian students to develop their own games using a freeware platform, Game Maker. The study showed that game creation not only boosts students' creative potential, but also allows them to acquire skills and knowledge of computer use, develop sensitivity towards the

ideas of others, and take ownership of the final product. Their findings also show that an appropriate pedagogical approach can boost the benefits of using computer game design with students.

Board games

A game shell that combines elements of familiar board games with the interactivity and appeal of contemporary online games was used in this study. Board games are recognized as tools for early literacy development (Lyle, 1999; Saracho, 2000, 2002). Researchers argue that forming a positive attitude towards reading and literacy through playful and entertaining activities, such as board game playing, helps develop avid readers (Sonnenschein, Baker, Serpell & Schmidt, 2000). Lyle (2000) found that student literacy skills were enhanced by teaching geography using a range of literacy-specific activities including creating a board game. She argues that writing game instructions and creating game cards fosters development of writing skills and engenders student enthusiasm. In a project focused on literacy development in an after-school playground that combined electronic and board games, Blanton, Greene and Cole (1999) found that playing board games is associated with developing literacy and essential learning skills, including language comprehension, social skills required for collaborative learning, and task persistence.

Digital literacies framework

In response to the call of the New London Group (1996) to reconceptualize literacy as complex and multiple, the concept of digital literacies has emerged to describe skills and practices associated with manipulating digital symbols to create meaning. Significant shifts in the technological landscape, and related questioning of what it means to be literate, have driven a rethinking of literacy in the 21st century. The old basics of reading and writing are now outmoded; new literacy basics include navigating digital environments, reading and writing with digital tools, blending readership and authorship, developing collaborative reading and writing skills, and engaging critically with new digital media and the texts they enable.

The research mission of the overarching study (Owston et al., 2007) aimed to combine the benefits of game play and game development described in the literature in an investigation of what learning and literacy development opportunities were offered through having students create and play their own games. By giving students a digital tool to develop their games, the research team envisioned a platform for them to engage with curricular content and gain skills in manipulating language and digital media while tapping into the appeal of digital play to create a sense of ownership, pride, and enjoyment from game play.

Our case study, which followed the institution, development, unfolding and culmination of the experimental geography game unit in two classes, was framed within the conceptual umbrella of digital literacies to examine whether and how computer games can be used in the classroom to develop meaningful literacy skills. We considered skills allowing students to manipulate digital technologies and environments (or digital metaliteracies), building understandings of and skills and practices in using digital technologies meaningfully, and manipulating the word (facilitating literacies in a traditional sense, but in a non-traditional digital environment). The project contributes to an understanding of digital literacies by investigating the potential for gaming

environments to develop both older alphabetic and new digital literacies, documenting how computer games can be conceptualized as a digital literacy environment, and describing what literacies can be developed by engaging students in game development and game play.

The case study

A comparative case study design was used to document the experimental game implementation in two public elementary schools located in the York Region District School Board. Two Grade 4 classes were studied to capture the process of implementation of an online computer game unit to teach Grade 4 geography in two different school contexts; this unit was being tested for effects on literacy development in a multisite experimental study in nine public schools across southwestern Ontario (Owston et al., 2007). The two schools were taking part in the quantitative study; both were in the experimental condition.

The purpose of conducting the case study was to draw a nuanced picture of the implementation and development of board game construction and play as geography and literacy learning in two different school contexts. Yin (1993) describes case studies as "the method of choice when the phenomenon under study is not readily distinguishable from its context" (p. 3). We were interested in the teachers' reception to and implementation of the experimental geography unit in their respective classrooms, particularly their approach to and utilization of technology and their introduction of game programming and play as curricular learning. We also wanted to capture the children's responses to the unit, and to observe the kinds of literacy skills being reinforced in game unit activities, which would add contextual and procedural perspectives to statistical test results in the multisite experimental study.

Procedure

Yin (1993) notes that the richness of data in a case study calls for multiple data collection methods. Across the January to May period of 2007, both researchers made nine half-day visits to the two schools. We visited each class together, separately collecting data on participant perspectives, experiences, and attitudes on the implementation, efficacy, enjoyment, and problematics of game development and play for geography learning via non-participant field observations, photography of daily activities, and informal conversations with both students and teachers. Directly after each school visit, we had an informal meeting in a local coffee shop to transcribe both sets of observations and merge them into a single record, which facilitated recall, discussion and comparison of observations and incidents of particular interest.

The games

The experimental geography unit to be taught and learned through board game construction and play was designed to address the need to develop both traditional and digital literacies in students within a school setting, and to engage students in interactive learning experiences. Four online board games were created and played by the children: *Tic-tac-toe*, *Trivial Pursuit*, *Snakes and Ladders*, and *Mother Goose*. The game shell used in the study was developed by Savie, and is a web-based free service available online at the *Education Games Central* website (http://www.savie.qc.ca/carrefourjeux2/).

To create a game, students had to develop a set of questions and answers and enter

them into online forms. Their saved programs were later rendered as Flash games that were playable by any players on *Education Games Central.* Each game required a different minimum number of questions for the game to function: *Tic-tac-toe* - 16 questions; *Snakes and Ladders* - 27 questions; *Mother Goose* - 44 questions, and *Trivia* - 54 questions.

In this system, game developers have the option of changing the feedback a player receives when a question is answered correctly or incorrectly. They can also add links to web or textbook resources in the questions. Figure 1 illustrates a question creation page.

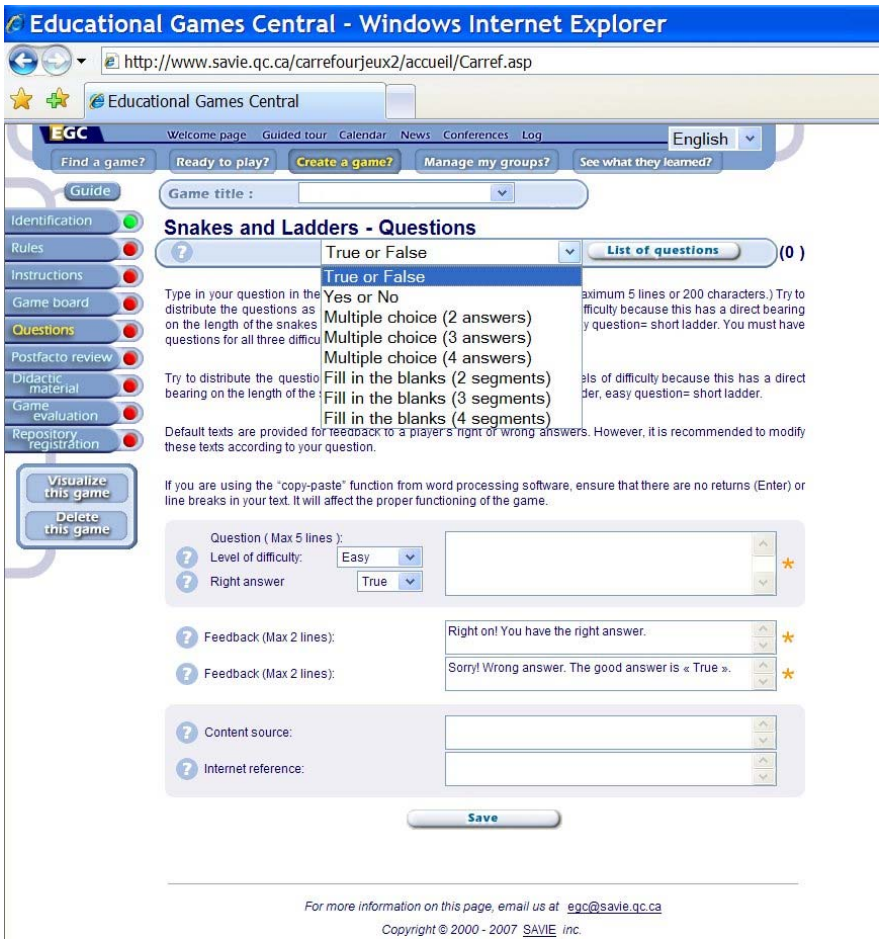

Figure 1: **Educational Game Central - Game creation screen for *Snakes and Ladders***

When playing the game, players are presented with a question from the game which they must answer correctly before advancing on the game board (see Figure 2 for an example of a game play screen). The game shell was originally created in French, but was later translated into English and Spanish.

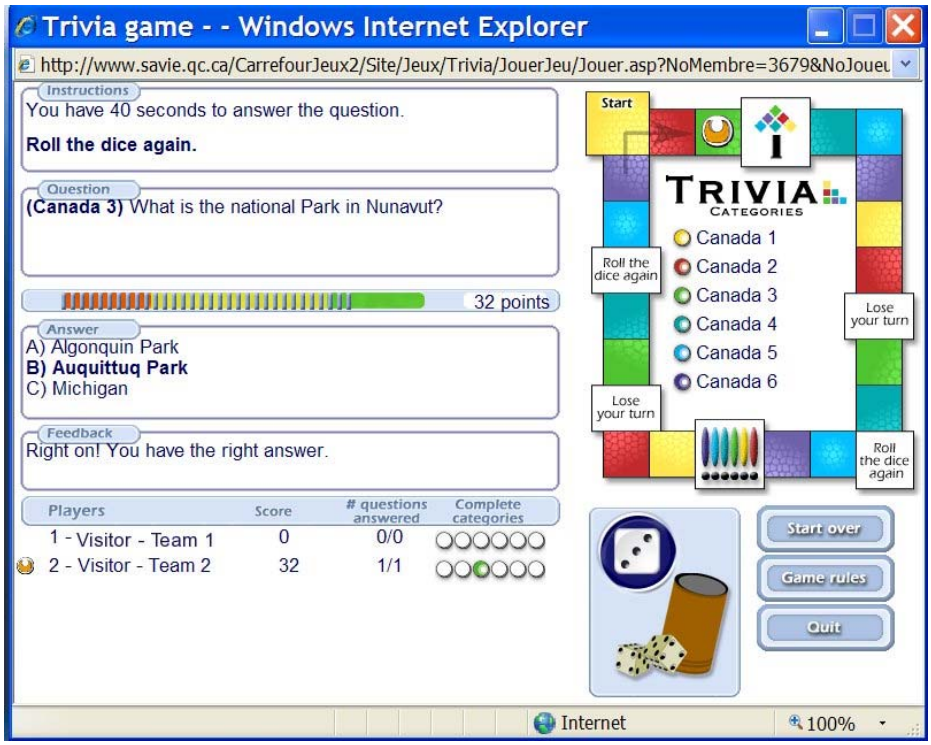

Figure 2: **Educational Game Central - Flash-based Trivia game**

Context

Northern Public School[2] (NPS), which opened in 1997, is located in an upper middle class suburb in the northern fringes of the Greater Toronto Area. The school has a square formation with individual classrooms around a courtyard comprising the gym with a movable wall backing onto a spacious stage and library-lab. It is here that the children do most of the programming and playing of the games they have drafted on paper in the classroom. Two other pods of desktop computers line the walls at different points in the school. Two mobile laptop labs are also available to teachers.

There are 24 children in the experimental Grade 4 class at NPS: 12 boys and 12 girls. The class has minimal visible or audible cultural diversity. Ms Green, their teacher, is passionately involved in school activities and holds the respect and attention of her students. She is friendly and helpful, publicly acknowledging and including us in class consultations over game performance during each class observation.

Southern Public School (SPS) opened in 2003. It is located in a more modest middle class community in another bedroom suburb in the northern Greater Toronto Area. The Grade 4 experimental classroom is on the second floor of the school, located within an innovative pod arrangement bordering a mutual workspace with three other classrooms. There are 27 children in the class: 13 boys and 14 girls. Approximately one-third of the children are visible minorities. The teacher, Ms Brown, is a young woman who greets us informally and leaves us to do our research. Throughout our visits, she politely responds to our questions when approached, but otherwise does not publicly acknowledge or include us in any aspect of the class. The children at SPS complete all work pertaining to

this project in the classroom where they have access to a well worn mobile laptop lab, and in an adjoining pod workspace, which contains desks, four desktop computers, a SMART Board, a printer/photocopier, and telephone. The children work with minimal supervision.

Data analysis

The researchers jointly coded the complete data set by negotiating and creating codes in close consultation over several meetings, and by focusing on themes and patterns in the data set (Bogdan & Biklen, 2003). To facilitate data coding and analysis, all data gathered in field notes, photographs, and participant commentary, including pictorial, were coded using ATLAS.ti v.5 qualitative software, and analyzed in accordance with qualitative procedures (Marshall & Rossman, 2006) to comparatively describe the teachers' pedagogical incorporation of the geography unit via gaming, and the children's evolutionary progress in developing, programming and playing the four board games in digital format using a game shell accessed online. The result was a collection of 15 observational variables, clustered around attitudes and approaches to teaching and learning the games unit; participation and engagement; and technological integration at school. These coded observations were augmented by two sets of evaluative commentary: the teachers' and the observers'. Observations are presented and discussed in a comparative narrative format focusing on each school context.

Observations

Though both schools were relatively new, each being less than 10 years old with good access to technological equipment, the computer equipment was approached, accessed and utilized quite differently in each school which, in turn, appeared to affect pedagogical practices and learning experiences. There were noteworthy differences in each teacher's integration of technology in professional practices and classroom pedagogy, her comfort with the available machines, and her attitude to exploratory learning on the part of the children.

Ms Green's class, Northern Public School

Attitudes and approaches to teaching and learning the games unit

In Ms Green's class, the game creation process was very linear. The children prepared their game questions on paper in pairs allocated by the teacher. They found their way onto the game site following blackboard instructions, and experienced myriad problems that the teacher answered to individually. Though these middle class children chatted about their home computers and digital practices, including games, they manifested poor computer literacy in the classroom, experiencing problems with the URL, and common functions, such as how to save, edit and find their way around the game site.

Ms Green's lack of comfort with children's learning through creating web-based digital games was apparent in her teacher-centred approach. Though she was an experienced teacher who incorporated multimodal learning, Ms Green did not gravitate to technological mediation; she worked towards content learning rather than technological fluency in this project. Children consulted various print resources in question creation; Ms Green was pleased to see the popularity of such resources in this activity. For instance, in the map learning segment, the substance of one of the online games, she had the students create their own treasure maps that included the major

parts of the map (e.g., legend, compass, directional lines, scale) as had been taught. The children recommended resources from their own experience, including *Pirates of the Caribbean*[3]. After the children created treasure maps of the classroom, they were encouraged to walk their maps to make sure they worked, which was fun and engaging hands-on learning.

There was a lot of associated frustration with game crashes, and bad saves resulting in lost questions by students in Ms. Green's class. As such, the games did not lend themselves to deep learning: they required mainly true-false, multiple-choice, and yes-no question types, so much of the children's orientation was to superficial learning. Many questions were simply factual retrieval, e.g.: "What's the capital of ____?" With practice, better questions emerged, e.g., "What is a cartographer? A person who makes carts; a person who draws carts; a map-maker;" but there were still many poor questions, most not envisioning the scope of the online audience. The superficiality of the questions required of the game shell informs the quantitative finding that children did not show significant improvement in tests of reading and writing (Owston et al., 2007).

Ms Green was visibly uncomfortable when there was a problem with the technology, and in one instance, rather that working on finding a solution to a minor meltdown occurring somewhere between the school's system and the game site or giving the children the opportunity to play another of the games they had completed for this unit, she asked all the children to switch off the program and open either Kid Pix or another educational game that she was more familiar with. It is possible that system crashes at her school were exacerbated by the lock-step, linear organization of her class, which orchestrated all kids being at the same place at the same time.

A most interesting unintended learning opportunity arose with a game bug: *Mother Goose* was available only partly in English with French and Spanish variants that baffled, amused, then, interestingly, engaged the children in unintended learning (see Figure 3). They used a variety of strategies to figure out cognates for *facile; facil* [easy] and *difficile; dificil* [difficult], and were found to enjoy the experience though it had eventuated from an incomplete translation – essentially a game glitch. One little girl at NPS, where there was relatively little cultural diversity, had been very quiet up till the *Mother Goose*/*Jeu de l'oie/Juego de la oca* segment, when she suddenly became very talkative using to her group's advantage the Romanian she spoke at home to form cognates in these fellow Romance languages.

Figure 3: **Juego de la oca (Mother Goose in Spanish)**

The children had not learned to touch type (at either school), though touch typing is a basic literacy "skill", especially in schools with a vested interest in technology. Therefore, a great deal of time was spent in typing questions created on paper in the classroom into the game site, which reduced the games project to a typing exercise on numerous visits. This caused the children some degree of boredom and frustration, and reduced the learning potential of the unit. However, both teachers noted that the students' keyboarding skills improved during the unit because they had to type in their questions.

In the creation of their games, the children did not appear to understand that digital networking enabled people beyond their classroom to play their games. Despite their lack of Internet awareness, children improved their skills of accessing the Internet and operating a web browser. Whereas at the beginning of the project students at NPS stopped dead in their tracks when they encountered a standard IE security warning, at the end of the project they were reading the browser quite freely, navigating different windows and buttons effortlessly.

The prescribed, highly sequential game creation process did not work towards elucidating the public nature of the games; there was a clear disconnect between the kinds of questions kids input on the game shell and their answerability from the potential online audience, e.g., "Where is X's desk relative to the carpet?" (north - south - east - west). This observation is reflective of the broader tensions between public and private spaces online which Boyd (2008) takes up in *networked publics*: "the spaces and audiences that are bound together through technological networks" (p. 125). The game creation was mediated through the technology in a way that removed the students from

the ultimate audience – the thousands of people on the gaming network who have access to the game site, and hence to the games created by these students.

Participation and engagement

For all but the first game (which was programmed in the classroom using a mobile lab), the children were lined up single file to walk quietly to the library-lab (see Figure 4), where they used the machines under the direct guidance of the teacher, who insisted on quiet work, and became flustered when there were problems.

Figure 4: **Children in NPS lab-library**

The children had variable attitudes to creating and playing the games, though no one seemed to have much time for actually playing the games they had created (in either context). When they played their games, they generally enjoyed them. Ms Green noted that children's abilities to cope with linguistic variability improved over the course of the game, given French and Spanish versions which the students found fun to figure out. Students' approaches to reading in other languages were extremely interesting, including using language cognates, recognizing words from French lessons, and using game architecture to structure guesses.

Overall, it was observed that the experimental game creation process was sidelined by tedious, inefficient typing of questions from paper onto the site, with children routinely running out of questions which were then marked by convenience and desperation rather than thought or creativity. With few opportunities to actually play the games they had created, the "play" objective of the games-creation process slid into drudgery. Ms Green offered an external reward for creating game questions: play itself was not seen as a reward. Game creation thus overpowered game play, and the purpose of the activity to build towards engaging game playing was lost, giving little payoff to arduous question creation and reproduction in programmed form.

Technological integration at school

In Ms Green's classroom at NPS, digital technology was external to regular literacy practices. The class went to the library to use desktops for all games but the first, which they did in the classroom using a mobile laptop lab. The NPS laptops were relatively new, clean-looking Dell Latitude computers but teacher and students alike were uncomfortable using them. Ms Green's instructions were marked by admonitions about using expensive technology with attention, care and relative quiet and her rules for the use of laptops in the classroom, included: "No water bottles or food on the desks, no running with expensive stuff in the room." Children were not encouraged to explore the machinery itself. When one child exclaimed: "I wish we could make the fonts bigger", the teacher exhorted not to fiddle with the computer.

At NPS, accessing, turning on, fixing simple problems with, programming, and turning off computers were strictly teacher-guided steps in linear progression with frequent reminders that the children be vigilant with expensive technology. The children were clearly uncomfortable handling "new" equipment that differed from what they were accustomed to, which was in dramatic contrast to the children at SPS, who literally read the machines. At NPS, the children did not understand the laptops they used in the classroom on the researchers' first visit, complaining that they were big people's computers that required them to use a mouse pad. When the "low battery" light flashed on a number of computers, it was apparent that no one knew how to attach the mobile lab laptops to power outlets.

The teachers at NPS, for the most part, had limited knowledge of how to fix technical problems; one teacher was good with technology, though not to the extent of "fixing" broken computers, which according to Ms Green, was a frequent occurrence. Technology support was described as weekly, shared across the school board.

Ms Brown's class, Southern Public School

Attitudes and approaches to teaching and learning the games unit

Ms Brown utilized technology naturally in her introduction to the game site and the unit exercises by demonstrating game access and question inputting on her laptop projected to a screen in the classroom. She asked children to bookmark the website on their laptops. Children were expected to know the site URL, class username and password. The teacher recorded the website address on the whiteboard behind the screen, and asked children to save their individual games immediately to prevent losing questions to game or computer crashes.

Ms Brown was clearly accustomed to working with technology in the classroom and the mobile lab was brought in for each game the children made, supplemented by computers in the adjacent pod and her own laptop, which she allowed the children to use when needed. The children were well versed in the use of the mobile lab. They accessed, turned on, fixed simple problems with, programmed, turned off and put away the machines with great familiarity and minimal guidance. The class had an organic child-paced organization; the children moved to the appropriate website on their own and in their own spaces, which included sprawling configurations across chairs and on the floor.

For the first game, Ms Brown had the children compose their questions online, but the questions were so poorly written that she had to edit them herself, so she decided to have the children compose their questions on paper beforehand. In this way, Ms Brown

moved towards a more teacher-centred, linear paper to screen pedagogy as the study advanced. To circumvent the problem of kids directly inputting poor questions rife with factual and grammatical/mechanical errors, she implemented programmed sheets in a notebook, which she monitored and marked for credit.

The nature of the games themselves became an interesting issue. Since the online games were based on existing board games, it was interesting to see whether they would lend themselves to an online environment. Children varied in their familiarity with the board games in question: some had played them with parents; some had never been exposed to them. Several children were not familiar with *Mother Goose*, indicating both generational and cultural gaps in relating to the games.

A noteworthy problem with the questions was that students (in both contexts) did not understand the online nature of the games: many questions asked had physical referents, e.g., "What is my city?" This indicated that children were unfamiliar with the concept of digital networks, which enabled people beyond their classroom to play these games. This lack of Internet literacy was reinforced by both teachers. Ms Brown, for example, required that a certain number of questions be asked on the location of objects in the classroom.

Participation and engagement

The children at SPS collaborated noisily in informal groups on the floor, at desks in the classroom or in the adjoining pod, and accessed the teacher or other children when help was needed (see Figure 5). However, those with poor discipline or work ethic wandered around aimlessly indicating that creating functional groups at this age has its challenges.

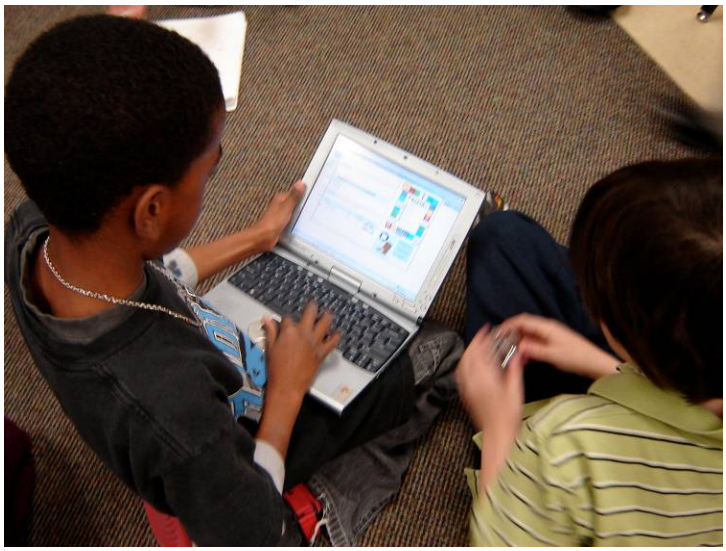

Figure 5: **Children in SPS Grade 4 classroom**

The limited number of computers facilitated collaboration: children needed to work together as there were not enough computers for each student (at either school), which is typical not aberrant. The children manifested different collaborative patterns: some

pairs or groups worked well together; some individuals competed with each other for maximum screen time; some children functioned more or less on their own, though sitting in a pair or group; some were collections of disengaged individuals. As the project advanced, groups found different cohesive strategies, e.g., designating a "leader" who was seen to be smart; and group personalities emerged in Ms Brown's child-centred class. Collaboration also worked remotely, with children checking on a split group's (working at two different computers) accomplishments digitally. Only one group (of boys) at SPS was observed to be working collaboratively and critically, thinking through the questions and correcting them together.

Though there were limited opportunities to play the games children had created, game playing was seen to be highly engaging, for the most part, with groups of children excitedly focused on their screens (see Figure 6). However, too many children awaiting their turn to play on one computer made for a degree of (understandable) frustration and impatience.

Figure 6: **Excitement in game playing - Boys playing their own games at SPS.**

Technological integration at school

Both schools chose to be in this study because they were predisposed to the use of technology in learning, though SPS, as a pioneer in technology-enhanced learning (TEL), had teachers with greater experience in technology-infused pedagogical practice, and better organized in-house technical support. SPS's deeper historical connection to TEL was obvious in Ms Brown's teaching environment, which was technologically immersive.

The mobile labs at NPS and SPS made for an interesting comparison. The mobile laptop lab at SPS was a mixture of worn Dell Latitude machines and a few old HP computers. The children recognized the different power cords, and utilized the lab with great familiarity. By the end of the project, the lab had been refurbished with small and flexible Acer notebooks, which the children quickly adapted to and were observed to be using with occasional keys missing from the keyboard: well-loved machines.

The SPS lead technology teacher was able to fix quotidian technical problems in

response to an email for help. For instance, a preliminary difficulty accessing the game site at SPS, due to the school board's web access prohibitions, was solved in-house when the technology teacher customized a solution for school access to the game site. Problems calling for help above what the teachers themselves could sort out, though, amounted, as at NPS, to a weekly board-level visit.

There were many programming issues and bugs in the games that needed attention. Interestingly, technical problems seemed to be less important in the SPS class where technical support was higher, confidence and experience in using technology was higher, and fear of technology was not apparent. The children had free rein and were observed reading the machines for low battery indicators, appropriate connections to power cords, and so forth. They collaborated with each other to fix minor problems as well as asking the teacher. Ms Brown noted that despite myriad bugs in the games that made the games freeze mid-play, the kids didn't seem to mind playing "a bunch of half games".

Evaluating the use of online board games for literacy learning

The teachers learned many valuable lessons from their experience of teaching geography through the use of online board games. Ms Green saved students' questions for use in future games, building a content-based question bank. She suggested that by building progressively on questions to reframe them as higher order question types, the game shell could utilize higher order questions in its programming facility to maximize subject content and literacy learning. Ms Green noted that the quality of the questions improved greatly with students' reusing, and editing questions. Ms Green also felt that children learned to cooperate better through their collaborative gaming experience, and that their keyboarding skills and abilities coping with linguistic variability improved over the course of the game. She felt that the games were useful, and were highly applicable to other content learning, e.g., math, and environmental studies.

Ms Brown felt that it took too much time to set up the computers, log on, and type the questions in, especially given the children's poor typing skills, though she found the games to be highly motivational, and fun to play. She noted that the collaborative nature of game production and play meant that it could not be used for traditional (individual) assessment, and made the insightful suggestion that teachers create a sample game with high-quality questions that kids can play to see how to make good questions. She also recommended that it would be better to think about groups each being responsible for particular categories and sharing their questions afterwards in a jigsaw rather than competitive pattern.

The participating teachers recommended the creation of an online forum for teachers who used games in the classroom where they could share observations, problems, solutions, and responses to technical problems. Greater technological support and pedagogical freedom is clearly needed for teachers to utilize online sites, such as the game shell, to greater advantage in their learning contexts. Schools and school boards need to be aware of their roles in facilitating conversations about and supporting use of digital technologies in the classroom. Teachers need opportunities to explore teaching possibilities without fear of technical collapse. These opportunities can be facilitated by a more supportive infrastructure both online between schools, and in terms of human resources within schools. Facilitating collaboration between teachers can support learning how to handle some of the technical support stumbling blocks that Ms Green, in particular, faced in her school context.

In this project, learning and engagement were not ensured by the availability of technology. For instance, a SMART Board sat unused in the library-lab of NPS on every visit, though it could have been profitably used to demonstrate access, and debugging approaches to the game site - which definitely needed debugging. Further to this – it is recommended that a feedback loop be programmed into the game site so children's comments on game bugs can be sent directly to the game shell webmaster.

Children needed more school-based digital literacies for game creation to be valuable to them. Though working with digital literacies is inherently collaborative, the group size and shape appeared to affect how children collaborated, problem-solved and played games. Many children were engaged, for the most part, in a typing exercise, rendering a potentially fun activity inefficient and clerical. Children would benefit from keyboarding skills being introduced into the literacy curriculum, as well as being allowed to explore computers and controlled online environments, such as this game site, in order to be able to read them, too.

This project missed the opportunity to emphasize an important aspect of digital literacies: the understanding of the public nature of the Internet. There are important implications for how students approach the public Internet. In an age of online social networking, where young people are perceived as being at risk of divulging too much of their personal information (Rosenblum, 2007), opportunities to explore the public nature of the Internet sites and how to approach them become invaluable for media awareness and safe use.

There are opportunities for improving language awareness using a game site, by employing spell-checkers in the game structure to remind children to proof their work, and by involving more bridges to multilingual access. In this study, problem-solving across languages was seen to be challenging and fun. This was one of the most successful elements of literacy learning in this exercise, though an unintended outcome resulting from a translation glitch in the game shell. Curiously, problem-solving across technological glitches was reacted to anxiously. Consequently, valuable hands-on opportunities for computer literacy through collaborative problem solving were missed.

Summary and conclusion

This comparative case study of two Grade 4 classes engaged in gaming geography in the suburban GTA created a nuanced portrayal of the game-by-game implementation of an experimental educational game development unit for advancing literacy and curricular learning. Researchers observed children creating, programming and playing *Tic-tac-toe*, *Trivial Pursuit*, *Snakes and Ladders*, and *Mother Goose* digital board games based on specific geography content.

The case study was instructive in identifying the contextual supports and pedagogical resources needed for efficient utilization of an online game shell as a pedagogical tool to advance children's curricular and literacy learning. Online board game production was not seen to strongly influence traditional literacy skills in the form that it took in this research study (Owston et al., 2007); one reason for this is hypothesized to be the structure of the online games, which asked for yes-no and multiple choice questions, rather than higher order questions. Nonetheless, games creation was seen to be a promising means of fostering digital, cultural and multilingual literacies in both children and teachers, providing a useful, if challenging learning experience for participating

teachers and students alike (Lotherington & Sinitskaya Ronda, 2007).

Differences in teachers' integration of technology in professional practices and classroom pedagogy, and their comfort with the available technology and the networking capabilities of their respective schools appeared to affect the teachers' and the children's attitudes to and opportunities for learning. Where technology was normalized in teaching practice, both the teacher and learners were more comfortable with exploratory, participatory learning. The technology, per se, did not appear to make the difference; what was important was access to a reliable and responsive support network to help trouble-shoot technical problems. To create an environment sufficiently robust for the support of participatory, digitally-mediated learning requires the creation and maintenance of a coherent support network, shared by the school, school board and Ministry of Education. The teachers as well as the children enjoyed the games project and they felt they learned a great deal. Both of the teachers made useful observations about the progress of the games and provided valuable suggestions for using the framework of game creation for this and other subjects in the future.

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[2] Pseudonyms are used for schools and teachers.

[3] This is a Disney film production with commercial spin-offs.