A Study of Classroom Use of Educational Games and Simulations for Literacy Skills Development:

A qualitative sub-study of two schools

by

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Abstract

As a component of the study on educational game development as a learning activity for advancing student literacy, a qualitative sub study was conducted in order to collect more nuanced, context-rich information. The game development process was studied in depth in two experimental grade four classes through direct observation and student and teacher consultation. The children at both sites created four board games in digital format using a game shell accessed online for Tic-tac-toe, Trivial Pursuit, Snakes and Ladders, and Mother Goose. Though both schools were relatively new and had good technological resources, computer equipment was approached, accessed and utilized quite differently in each class which, in turn affected pedagogical practices and learning experiences. The availability of technology, and the quality of the machines in each school did not predict use. 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. Teachers' attitudes towards technology and their level of comfort with computers had a significant effect on student practices and learning. In the classroom where teacher was comfortable using technology, students were conversant in the language of the machines. In the classroom where teacher experiences difficulty integrating computers into her teaching, students had poor computer skills and demonstrated high levels of anxiety while using computers. It is important to note that as the study progressed, the teacher and especially the students in the second school became more comfortable with technology. Game development activity allowed students to improve their computer and specifically typing skills. In terms of literacy gains the progress was moderate, due to the nature of the activity that favoured quantity of questions and not quality. A number of recommendations are made based on teachers' comments and researchers' observations that will help improve the game development and play in the future.

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I. Background

As a component of the study on educational game development as a learning activity for advancing student literacy, a qualitative sub-study was conducted in order to collect more nuanced, context-rich information. The game development process was studied in depth at a selected sample of experimental grade four classes through direct observation and student and teacher consultation. The children at both sites created four board games in digital format using a game shell accessed online for Tic-tac-toe, Trivial Pursuit, Snakes and Ladders, and Mother Goose. The unit that was selected for the study after consultations with teachers was Regions of Canada – according to the teachers, this unit is dry and games were expected to help make it more exciting for the students. A detailed unit plan was created by an outside expert that was supposed to guide teachers through the unit. It included additional materials such as Hold on McGinty, and planned out game activities across the unit.

Two schools in neighbouring communities in the York Region District School Board were chosen for repeated visits and in-depth observation. Nine visits were made over a period of 4 months, as follows:

	Southern Public School[1]	Northern Public School
26 January *Tic-tac-toe*	1:30 – 3:00	10:30 – 12:30
22 February *Trivial Pursuit*	1:30 – 3:00	10:30 – 12:30
22 March *Snakes and Ladders*	9:00 – 10:15	10:30 – 12:30
10 April *Snakes and Ladders*	9:00 – 10:15	
9 May *Mother Goose*	9:00 – 10:15	10:30 – 12:30

Context

Northern Public School (NPS) opened in 1997. It is located in an upper middle class community in the northern reaches of the Greater Toronto Area (GTA), surrounded by new, large, single family homes with two and three car garages. The classroom teacher, Ms Green, informs us that the school catchment area also includes children from rented townhouse accommodation. Ms Green, is an experienced teacher who is deeply engaged with her students, 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.

[1] Pseudonyms are used for the schools and teachers.

There are 24 children in the experimental grade four class: 12 boys and 12 girls. The class has little visible or audible cultural diversity.

We are shown around NPS, which is built on 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 their programming and playing of the games they have drafted on paper in the classroom. Two other pods of desktop computers line the walls at two different points in the school. There are also two mobile laptop labs available to teachers. The mobile lab laptops are relatively new Dell Latitude computers. The laptops are used by the children in their homeroom only during our first visit. Use of the laptops as well as the lab computers is highly structured and monitored.

Southern Public School (SPS) opened in 2003. It is located in a modestly middle class community to the immediate south of Northern Public School, consisting mostly of semi-detached houses with single car garages. There is a small shopping centre at a nearby major intersection.

The grade four experimental classroom is on the second floor of the school in an innovative pod arrangement of a mutual workspace bordering four classrooms. There are 27 children in the class: 13 boys and 14 girls. We are informed that a new student will arrive shortly. Approximately one third of the children are visible minorities. One child is hearing impaired; another is gifted. 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 use a well worn mobile laptop lab in the classroom. It contains a combination of Dell Latitudes with a few old Hewlitt Packards, and as the study progresses, smaller, faster ACER notebooks are cascaded into the mobile lab. The adjoining pod workspace, in which the children also work, contains desks, 4 desktop computers, a Smartboard, a printer/photocopier, and telephone. The children work with minimal supervision. We are shown only this section of the school.

II. Evaluation objectives and methods

Data on participant perspectives, experiences, and attitudes on the enjoyment, efficacy and problematics of game development and play based on geography learning as an educational and literacy development activity were generated from non-participant field observations, and informal conversations with students and teachers. Observations were conducted jointly, each researcher taking individual notes (as well as photographs that did not identify children but characterized the context or activity), and speaking individually with children and jointly with participating teachers over the course of each visit. Immediately following each day's school observations, the researchers met to discuss individual observations and compare notes, which were promptly transcribed, edited and merged as entries in a shared journal containing triangulated field notes, pictures and observers' comments.

Using a grounded theory approach, qualitative data sources were coded and analyzed to gain a picture of how the project worked in each of the classrooms. In this approach analytic findings and theory are "inductively derived from the study of the phenomenon…. That is, [they are] discovered, developed, and provisionally verified through systematic data collection and analysis of data pertaining to that phenomenon" (Strauss and Corbin, 1998, p. 23). To facilitate data coding and analysis, all data, including pictorial, were analyzed using ATLAS.ti v.5 qualitative software.

The researchers jointly coded the data, negotiating and creating codes in close consultation over several meetings. Once the data set was fully coded, the researchers considered connections within and between codes then met to double check a sample of the coded data and to recode the data set for a further variable that had emerged in reviewing the coded data. The result was a collection of 15 variables, and two sets of evaluative commentary: the teachers' and the observers'.

III. Evaluation findings

Coded data fell into several distinct clusters around frequency of observations. The first and strongest cluster collocated **pedagogy, attitude** and **learning;** the second: **collaboration** and **engagement;** the third: **technology**, **students' technological skills, problems with game shell,** and **teacher's technological skills**. The final cluster of least frequently noted observations included **literacy, learning spaces, technical support** and a collection of socio-cultural descriptors, including **cultural diversity, socio-economic class,** and **gender**.

Cluster #1: pedagogy, attitude and learning

The **attitudes** of teachers and students to learning with technology were frequently noted observations. Though both schools were relatively new, each being less than 10 years old, and each had good access to technological equipment, computer equipment was approached, accessed and utilized quite differently in each school which, in turn, affected pedagogical practices and learning experiences. Both schools chose to be in this study as they were predisposed to the use of technology in learning, though SPS, as a pioneer in technology-enhanced learning (TEL), had greater experience in technology-infused pedagogical practice, and better organized in-house technical support. A pilot study was conducted in SPS, and was very successful, with teachers getting excited about the games, which was another contributing factor to selecting this school for in-depth qualitative observations.

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. In Ms Green's classroom at NPS, technology was external to regular literacy practices, whereas Ms Brown's teaching environment at SPS, which has a deeper historical connection to TEL, was more technologically immersive. In terms of lesson-writing practices, Ms Brown programmed her teaching unit preparation; whereas Ms Green wrote it out by hand.

Ms Brown utilized technology 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 Green, who closely followed the lesson progression around the fictionalized story of McGinty traversing Canada in his dory, which was recommended in the unit planner designed by the researchers, asked children to write their questions on paper using class resources. The children, working in pairs allocated by the teacher, found their way onto the game site following blackboard instructions with 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. Her instructions were marked by admonitions about using expensive technology with attention, care and relative quiet. 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.

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 teacher's 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." The children sat two to a laptop at their desks, sharing input. They complained about the laptops, which they understood as adults' computers with no mouse, and described the desktops in the lab, which they were more accustomed to using, as "computers".

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 KidPix 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, compared to SPS, which had a more organic, and chaotic child-paced organization.

Ms Green was a strong teacher depending on multimodal learning, much of which was non-technological; she worked towards content learning rather than technological fluency in this project. 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. 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.

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 equally well versed in the use of the mobile lab, and they accessed the lab, selected computers, turned them on and moved to the appropriate website on their own and in their own spaces, which included sprawling configurations

across chairs and on the floor. Ms Brown allowed the children to move at their own pace, and in their preferred spaces; she seldom asked for noise reduction and did little to corral one or two itinerant children who did not seem to function well within a group structure.

For the first game, Ms Brown had the children compose their questions online, but the questions were so bad that she had to edit them herself, so she decided to have the children compose their questions on paper beforehand. So Ms Brown moved towards a more teacher-centred and linear paper to screen pedagogy as the study advanced. She implemented programmed sheets in a notebook to monitor individual question creation and correction and mark this as desk/homework. She explained that this circumvented the problem of kids directly inputting lousy questions rife with factual and grammatical/mechanical errors. However, the teacher-centredness and guided linearity took something away from the spirit of the exercise.

The children had variable **attitudes** to creating and playing the games, though they did not seem to have much time for actually playing the games they had created in either class. When they played their and classmates' games, they generally enjoyed them. However, the experimental game creation process was observed to get 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 objective of the games-creation process: play, slid into drudgery. Ms Green offered an external reward for creating most game questions: play itself was not seen as a reward. Game creation thus overpowered game play, and the purpose of the activity was lost, giving little payoff to arduous question creation and reproduction in programmed form.

There was a lot of associated frustration with game crashes, and bad saves resulting in lost questions (particularly at NPS). 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, and getting "enough" questions to be able to play the game, which did not seem to function as a very effective motivation for them. 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. In NPS the same question "Where is Wayne Gretzky from?" was used at least three times by different groups of boys. They were writing games for their classmates rather than for a digital community of children across Canada. Many questions devoted to map-making and directions were centered around the classroom, e.g. "Where is my desk?", making it impossible to answer not only to a wider audience across Canada, but even to their classmates.

Ms Brown gave students question quotas to guide their thinking, e.g.: "Five should be on their province, five on one other province, at least one on mapping." The questions the

children created revealed that many children (in both classes) did not really understand the online connectivity of a web-based game, e.g.: "Where is X's desk relative to the carpet?" (south-north-east-west)

Though Ms Brown felt that games were fun and children enjoyed playing them, she 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.

Learning was coded as **intentional** and **associative** given the different kinds of learning that were observed. A most interesting unintended learning opportunity arose with a game glitch: Mother Goose was available only partly in English with French and Spanish variants that baffled, amused, then, interestingly, engaged the children in unintended learning. 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.

The teacher as well as the children learned a great deal from the games project. Both 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. Both noted, however, that the experimental process was too long, with too many games all in all. They found that too many questions were needed in each game, demanding superficial questions based on limited content. Ms Green put the games study away for three weeks on one occasion as the children were getting "gamed out". Nonetheless the study was felt to be motivational.

Cluster #2: collaboration 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. However, those with poor discipline or work ethics wandered around aimlessly indicating that creating functional groups at this age has a few challenges. This was also apparent with game-playing: too many children awaiting their turn to play on one computer made for understandable frustration and impatience.

At NPS, children were lined up single file to walk quietly to the library-lab, where they used the machines under the direct guidance of the teacher, who insisted on quiet work, and became flustered when there were problems. She shut down the learning process when technical problems in the games were oppressive, directing children to other sites or games, rather than to playing one of the other games they were creating in this project.

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; one child at SPS appeared to be more disruptive than helpful to any group. As the project advanced, groups found different cohesive strategies, e.g., designating a "leader" who was seen to be smart; and group personalities emerged, particularly in Ms Brown's class at SPS, which was more child-centred. 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.

With collaboration comes **engagement**, which was most clearly seen with game playing. Though there were limited opportunities to play the games children had created (and those of other children), game playing was seen to be highly engaging, for the most part, with groups of children excitedly focused on their screens.

Cluster #3: technology, students' technological skills, problems with gameshell, and teacher's technological skills

The availability of technology, and the quality of the machines in each school was not seen to be an indicator of use. A Smartboard 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. At SPS, the Smartboard was used by the control group but not by the experimental group, though they did utilize a screen projecting the teacher's laptop in class.

The mobile labs were an interesting comparison. The NPS laptops were relatively new, clean-looking Dell Latitude computers but teacher and students alike were uncomfortable using them. The teachers, 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.

At SPS, the experimental classroom is in a pod arrangement of four classrooms bordering a mutual workspace, containing an assortment of technological resources. At that school, the lead technology teacher was able to fix quotidian technical problems in response to an email for help, but problems calling for help above what the teachers themselves could sort out, amounted, as at NPS, to a weekly board-level visit.

The mobile laptop lab was a well worn mixture of Dell Latitude and a few old HP computers. The kids recognized the different power cords, and utilized the lab with great familiarity. A preliminary difficulty accessing the game site due to the school board's web access prohibitions was solved in-house by the technology teacher who customized a solution for school access to the game site. 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 nature of the games themselves became an interesting issue. Since the online games are 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 have played them with parents, some have never been exposed to them. One girl commented on Snakes and Ladders: she played it at home with her parentson a big carpet, and thought it was more exciting in the physical than the digital world. Several children were not familiar with Mother Goose (as was one of the researchers who was born outside of Canada), showing there might be a generational and cultural gap in relating to the games. On the whole however, the games' format was very well received by the students.

There were many programming issues and bugs in the games that need to be addressed by the researchers. However, interestingly, technical problems seemed 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 the myriad bugs in the games that the kids didn't seem to mind playing "a bunch of half games".

At NPS, technical glitches shut the games project down completely on more than one visit. Problems were reacted to with anxiety; children were not invited to experiment with ideas for getting around glitches. In this way, opportunities for computer literacy through collaborative learning and problem solving were reacted to anxiously as obstacles rather than learning challenges.

Cluster #4: literacy, learning spaces, technical support, and social markers {cultural diversity, socio-economic class, and gender}**.**

It was surprising that **literacy** was not a more common observation. This may be because traditional literacy: reading and writing and the conventions around written language, was not a strong feature of game involvement. There are clearly opportunities for improving language awareness, by employing spell-checkers in the game structure to remind children to proof their work, and by involving more cross-language work, such as what happened when games reverted to French or appeared in Spanish. 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. Children also consulted various print resources in question creation; Ms. Green was pleased to see the popularity of such resources in this activity. She also 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. The students coped with French when they played each others' games, though they didn't seem to relate directly to the French class they were finishing when we walked in.

The children had not learned to touch type at either school, though touch typing is a basic contemporary 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, teachers noted that the students' keyboarding skills improved during the unit because they had to type in their questions. Ms Green has built her students' stronger typing skills into a future digital movies project.

At SPS, the children accessed, turned on, fixed simple problems with, programmed, turned off and put away the machines with great familiarity and minimal guidance. At NPS, these steps were strictly teacher-guided in linear progression with frequent exhortations that the children be vigilant with expensive technology. The children at NPS were clearly uncomfortable handling "new" equipment that differed from what they were accustomed to, in clear contrast to the SPS children, who literally read the machines, identifying which cord to use with which machine, when to locate a power cord to safeguard data if the battery was low, and what it meant when various computer lights were lit. They worked with what they could find, having developed preferences and means of overcoming shortcomings in different pieces of hardware. The children at NPS, on the other hand, 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 mousepad. 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 points.

Many of the game questions were quite poor in content and language both. Ms Brown noted that after the first games were created she went back into the gameshell and changed many of the questions, thinking that they were written too poorly. Problems like spelling mistakes, incomplete sentences, questions seeking factual information were frequent. Distractors in multiple choice questions were sometimes poor, as well, e.g. "Which is Quebec's tree? White pine, yellow birch, just a tree".

A most noteworthy problem with the questions was that students did not understand the online nature of the games: many questions asked had physical referents, e.g. "What is my city?"; "Where is X's desk relative to the carpet?" This indicated that children were unfamiliar with the concept of online game, where people beyond their classroom will be able to play these games. It is all the more surprising since some students candidly played

board games created by outsiders, for example a Tic Tac Toe game on cats and dogs. This lack of Internet literacy was reinforced by teachers. Ms Brown, for example, required that a certain number of questions be asked on the location of objects in the classroom.

Despite this 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 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.

Learning spaces in both schools included good access to computers, and multipurpose rooms. Though **technical support** was the same for both schools at the board level, the schools had different human resources, and different technological infrastructures; this may reflect each school's experience in TEL, though this is conjecture at this point.

Comments on **cultural diversity, socio-economic class,** and **gender** were made generally in the context of identifying populations though some interesting observations on learning were made:

- In terms of socio-economic class, it was interesting that in the wealthier neighbourhood of NPS, where children talked with great enthusiasm about their favourite digital games and digital toys and their, in some cases, considerable experience playing various games at home, they had much poorer academic familiarity with computers at school on the whole, indicating that digital literacies are NOT something that can be left to recreational learning, as many would rationalize.

- Regarding gender, it was noted that groups of boys playing their games seemed to be more technology focused, and perhaps more excitably enthusiastic about playing the games. In one quite astonishing case at SPS, one little boy, who had been decidedly disengaged at the level of game creation, became totally, physically wrapped up in playing the games with a group of boys. Their excitement was palpable.

IV. Conclusions and recommendations

Teachers' observations

The teachers learned many valuable lessons from their experience of teaching the games creation project.

Ms Green saved students' questions for use in future games, creating a bank of questions. Her students saved questions from their early games on paper in class and then reused and edited them to use in different ways in different games. This is an excellent literacy activity, essentially built on process writing. Building on previous games to create new questions encourages higher level thinking, as well as revisiting geography content. 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 suggested that a project meeting mid-way through the study would allow teachers to collaboratively gauge their progress, talk about what works and doesn't work. Ms Green further noted that the games were useful, and she would use them for other subject areas. Her students ask if they can create questions on content such as math, and environmental studies, so they have been motivated to continue using the game structure.

Ms Brown noted, too, that she would use the games and would like more freedom in using them. She found attempting to implement the games to a research timetable difficult given that the teacher must respond to children and their needs as well as to study organizers. She felt the games were highly motivational: the children liked playing them. She made an insightful suggestion that teachers create a sample game with high-quality questions that kids can play and see how to make good game questions. She felt that learning how to ask questions is an important skill, and games are a good way to learn this.

Ms Brown thought the project to be a good learning opportunity, but not useful for traditional (individual) assessment due to its collaborative nature. She therefore marked children's pre-programmed handwritten questions for individual thinking. She also recommended that it would be better to think about groups being responsible for select categories each and sharing their questions afterwards in a jigsaw rather than competitive pattern.

The teachers' recommendations for using online board games for learning in the future include:

- building a content-based question bank, and working on it progressively, building on questions to reframe them as higher order question types to maximize subject content and literacy learning; this suggestion entails a critique of the game shell to utilize higher order questions in its programming facility;

- having children work on select categories of questions in groups within a jigsaw pattern (e.g., groups A-C do question sets 1 and 2; groups D-F do question sets 3 and 4), then sharing their results for a more collaborative and better thought out game or set of games;

- creating a forum for teachers so they can share observations, problems, solutions, responses to technical problems;

- using the game shells for other subject areas, e.g., mathematics, environmental studies;

- giving individual teachers more freedom to utilize the games module as they see fit for their students.

Researchers' observations

This qualitative study of two classrooms engaged in the online board games project was highly useful in identifying the contextual supports and pedagogical resources needed for efficient utilization of the game shell. Teachers need opportunities to explore teaching possibilities without fear of technical collapse. This requires networks both within and between schools. Facilitating collaboration between teachers would support learning how to handle some of the technical support stumbling blocks that Ms Green, in particular, faced in her school context. Schools and boards also need to be aware of their roles in facilitating conversations about and supporting use of digital technologies in the classroom.

Children need to acquire more school-based digital literacies for this game creation exercise to be valuable to them. Working from paper to screen in a linear fashion is at best a bridge to contemporary literary communication. Children need to bridge in and after school game playing. Their homework could include playing these games with their own parents, which was a suggestion seen at a school not included in this in-depth study. Children took pride in their game creation accomplishments, and should be given more time to explore playing of their games.

In this project, learning and engagement were not ensured by technology or by assignments. Though working with digital literacies is inherently collaborative, group size and shape of group affected how they collaborated, problem-solved and played games. In this introductory round, children were engaged, for the most part, in a typing exercise, rendering a potentially fun activity inefficient and clerical.

Nonetheless, everyone learned and the learning curve was quite steep for teachers.

The researchers' recommendations for using online games in the future include:

- providing teachers with better support in developing their technological competencies both within and between schools. Regular teacher communication utilizing an online structure to connect participating teachers such as that being piloted by the Ministry of Education in Learning Connections would be one suggestion. Schools need to foster a climate of participatory learning and provide basic technical support;

- providing students with more support for developing digital literacies, which entails connecting literacies between school and community practices. Teachers can ask children to play their online games with their parents, for instance. They can also creatively consider how children's out of school digital game playing could be incorporated into school learning is useful ways;

- reducing the number of games that students need to create, since it was found that creating four games is overwhelming and results in poor questions;

- allowing teachers to select subject areas and units for question creation as they see most fit, which would allow them to incorporate the games more seamlessly into their practice;

- providing assistance for children to learn to type effectively for school literacy purposes;

- employing spell-checkers in the game structure to remind children to proof their work;

- involving increased exposure to multilingualism as cross-language problem-solving was an inspiration to literacy learning.

Summary

Though we had many questions about what happened – or didn't happen - between our visits to each school in terms of the progression and continuity of the games project; online board game production was not seen as a successful means of fostering traditional literacy skills in the form that it took in this qualitative research study, but it was seen to be a promising means of fostering 21st century digital, cultural and multilingual literacies in both children and teachers, and a useful, though sometimes arduous learning experience for participating teachers and students.

Greater technological support and pedagogical freedom is needed for teachers to utilize this online site to greater advantage in their learning contexts. This can be facilitated by a more supportive infrastructure both online between schools, and in terms of human resources within schools. Where technology was normalized in teaching practice, both teacher and learners were more comfortable with exploratory, participatory learning.

Children would benefit from keyboarding skills being introduced into the literacy curriculum. Reading in multiple languages can be purposely introduced in this activity as multilingual literacies were seen to be challenging and fun. This was one of the most successful elements of literacy learning in this exercise, though an unintended aim.

The game site needs to be debugged. Why not involve the children in this process in a more collaborative way that utilizes their comments remotely?

References

Strauss, A. L., & Corbin, J. (1998). *Basics of qualitative research: Techniques and procedures for developing grounded theory* (2nd ed.). Thousand Oaks, CA: Sage.