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# Learning in a mobile age: an investigation of student motivation

**K. Ciampa**

Teacher Education Department, Brock University, St. Catharines, Ontario, Canada

**Abstract** The purpose of this single-case study was to explore the lived experiences of a grade 6 teacher and students who used tablets as part of their classroom instruction. Malone and Lepper's taxonomy of intrinsic motivations for learning is used as a framework for examining whether and how this particular theory of motivation applies equally well for mobile learning. This study reports on the grade 6 teacher's and students' perceptions regarding the motivational affordances of using these mobile devices for learning. The findings are consistent with those of Malone and Lepper that motivation can be enhanced through challenge, curiosity, control, recognition, competition and cooperation. This model is helpful in informing our understanding of the motivating features of using mobile devices for learning and how mobile technologies can be used to enhance learners' motivation.

**Keywords** digital games, engagement, iPads, motivation, mobile learning.

> Often students will be yelling out loud in class, but when we use the tablets, they're much quieter because they're paying attention to it. (Mark, Student, Grade 6)
>
> My students are excited and enjoy using the tablets and the apps, and are motivated to work on the tablet, so they do not get off task. (Natasha, Teacher, Grade 6).

## Introduction

Over the past decade, great strides have been made in investigating the cognitive processes involved in mobile learning (Shuler, 2009). During the same period, however, attention to motivational factors relating to mobile learning has been minimal (Sharples, 2007; Sharples, Arnedillo-Sánchez, Milrad, & Vavoula, 2009). In the opening quote(s), Mark, a grade 6 student, and Natasha, his grade 6 teacher, reflect on the observed differences in behaviour when students are engaged with tablets during language arts class. As evidenced by these self-reports, when children use tablets, they are generally found to be very engaged in the process: they are on-task and totally immersed in it with little or no awareness of the more general world around them (Beck & Wade, 2006; Csikszentmihalyi, 1990; Shaffer, 2006). Many learners are motivated and excited to use mobile devices; as yet, however, there is little understanding of what it is that makes learning with mobile devices so engaging and motivating to use. According to Malone and Lepper (1987), motivation is a necessary precondition for student involvement in any type of learning activity; what and how effectively students learn may be influenced by their level of motivation. Vogel, Kennedy, and Kwok (2009) claimed that students' motivation plays a significant role in engaging and sustaining students to use mobile devices for learning purposes. This study seeks to examine this taxonomy of intrinsic motivations through the lens of mobile learning. Malone and Lepper's taxonomy of intrinsic motivations for

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Correspondence: Katia Ciampa, Teacher Education Department, Brock University, 500 Glenridge Avenue, St. Catharines, ON, Canada L2S 3A1. Email: kciampa@brocku.ca

learning is used as a framework for examining whether and how this particular theory of motivation, which has been applied to non-mobile learning (Sharples, 2007), applies equally well for this new context. The purpose of this qualitative single-case study was to explore the lived experiences of a grade 6 teacher and her students who used tablets as part of their classroom instruction. More specifically, this study reports on the grade 6 teacher's and students' perceptions regarding the motivational affordances of using these mobile devices for learning. That said, this paper aims to describe how the use of mobile devices for classroom instruction relates to the theoretical accounts of what motivates students to learn. Accordingly, the following research question guides this study: What do elementary teachers and students perceive as the motivational affordances of using mobile devices for learning?

## Theoretical framework: taxonomy of intrinsic and extrinsic motivations for learning

Learning that is fun appears to be more effective (Lepper & Cordova, 1992). Also, Quinn (1994) argues that for games to benefit educational practice and learning, they need to combine fun elements with aspects of instructional design that include motivational, learning and interactive components. Deci and Ryan (1985) have noted that self-determined learner behaviour can stem from both intrinsic motivation (i.e., the learner engages in an activity because it is interesting or enjoyable) and from extrinsic motivation (i.e., the learner engages in an activity because he or she desires the outcome and wants to achieve some instrumental end such as earning a reward). In the past, research on motivation has mainly focused on assessing student motivation in a traditional classroom environment (Dornyei, 2000). With respect to technology-supported learning environments, however, research focusing on students' motivation is limited. As we create information systems to support programs and curricula, it becomes imperative that we understand the scope of technology-supported learning activities on aspects of motivation.

In line with the aim of this research study, Malone and Lepper's (1987) work on games focused particularly on what makes games both fun and educational. This early work used the existing literature on motivation backed up by a number of empirical studies to develop a theory of intrinsically and extrinsically motivating instruction for games. Malone and Lepper's theory is based on six categories of individual motivations that make an activity both intrinsically and extrinsically motivating for a learner and ultimately contribute to the fun in games. As discussed below, Malone and Lepper proposed that the following elements make an activity both intrinsically and extrinsically motivating for a learner: challenge, curiosity, control, cooperation, competition and recognition. It is believed that Malone and Lepper's motivation theory may provide important clues as to how and why mobile technologies are perceived 'fun', which can become powerful catalysts for change as well as tools for redesigning our learning and instructional systems. In addition to its theoretical contribution, this research presents important practical contributions through the identification of important factors deemed to support students' motivation in (mobile) technology-supported learning environments.

### Intrinsic motivations for learning

*Challenge*

While in a state of flow or while playing a game, learning is made possible through the use of concrete goals. To prevent the learner from wandering around aimlessly, a game creates goals that the user must meet before being able to progress. Malone and Lepper (1987) claimed that learners are more motivated when goals are clearly defined and when challenge is balanced in such a way that the learning process is neither too easy as to bore the learner, or too difficult such that success seems impossible. There are several ways in which an optimal level of challenge can be obtained. Malone and Lepper (1987) suggest that activities should employ varying difficulty levels of instruction, establish multiple levels of goals, vary time constraints, provide incomplete information and make the learner seek out the missing elements.

Most mobile games and 'apps' (applications used on mobile devices) also allow for self-selected differentiation of difficulty level at the start of the game (e.g., easy, medium, hard) where students can move through the levels at their own pace or automatically adjusted difficulty levels according to how the student performs (Chou, Block, & Jesness, 2012). The ability to adjust

content to student level and allow self-paced learning may thus lend mobile technology as an ideal tool for implementing differentiated instruction in the classroom.

Performance feedback and score keeping allows the individual to track progress towards desired goals. Finally, goals must be meaningful, personalized and specific to the individual; activities that are within the individual's zone of proximal development (Vygotsky, 1978) will stimulate the greatest intrinsic motivation (Malone & Lepper, 1987). Most mobile games and apps can also provide immediate feedback and thus provide continued motivation for those who are not motivated by traditional educational settings (Valk, Rashid, & Elder, 2010).

*Curiosity*

Curiosity is the most direct intrinsic motivation for learning. The concept of curiosity can be divided into two broad categories: sensory curiosity and cognitive curiosity (Malone & Lepper, 1987). Sensory curiosity involves the attention-attracting value of variations and changes in the light, sound or other sensory stimuli of an environment. When considering motivation within multimedia learning environments, both an individual's sensory or cognitive curiosity can be stimulated. Multimedia effects such as videos, audio, music, animation and interactive capabilities afforded by mobile devices evoke sensory curiosity (Liu, Toprac, & Yuen, 2009). Mobile devices such as the tablet also afford greater opportunities for haptic modality, a new channel for communication through mobile technology by utilizing the sense of touch (Wong, Chu, Khong, & Lim, 2010). The tablet, in particular, features flicking, tapping, pinching and stretching. These haptic touch features have enhanced the visual feedback which also enhanced the player's experience during interaction and gameplay (Wong *et al*., 2010).

Cognitive curiosity is also aroused when learners discover that their knowledge is incomplete or inconsistent, and they have the desire to explore and attain new information and competence with the technology (Malone & Lepper, 1987). Technology-enhanced environments afford individuals with almost limitless opportunities for exploration and ready access to information to support both sensory and cognitive curiosity (Liu *et al*., 2009). This desire for new information can lead to deepening levels of interest and vice versa (Malone & Lepper, 1987).

*Control*

The concept of control is another cornerstone of intrinsic motivation (Malone & Lepper, 1987). Deci, Betley, Kahle, Abrams, and Porac (1981) define intrinsic motivation as a striving for competence and self-determination (where self-determination means control). Researchers have indicated that locus of control is associated with motivation when students are given control over their learning (Klein & Keller, 1990). According to Malone and Lepper (1987), the 'mere illusion of control' significantly improves motivation and academic performance (p. 238). Control is determined by the range of choices offered by an activity, the extent to which outcomes are contingent on the responses of the player, and the inherent power of these responses (Joiner, Nethercott, Hull, & Reid, 2006). This motivation is best promoted when the activity provides 'a sense of personal control over meaningful outcomes' (Malone & Lepper, 1987, p. 258).

The role of choice in motivation is also well recognized (Gambrell, 1996). Opportunities for choice promote students' independence and versatility (Turner, 1995). Environments that provide choices and self-direction support the feeling of autonomy, which enhances intrinsic motivation (Deci & Ryan, 1985). Task engagement also increases when students are provided with opportunities to make choices about their learning (Deci & Ryan, 1985). The mobile user's ability to make his/her own choice is one of the pillars on which the success of ubiquitous mobile environments for learning rests. Mobile technologies have the potential to support and encourage the view of the student as a self-regulated learner and constructivist approaches to pedagogy both within and beyond the classroom by assisting the learner to interact with his/her environment, make independent choices and regulate their own learning (Beishuizen, 2008). In addition, the personal, multimodal, independent capabilities of devices such as the tablet offer the potential for 'anywhere, anytime' learning (Evans & Johri, 2008; Norris & Soloway, 2008).

## Extrinsic motivations for learning

Although extrinsic rewards can be less effective than intrinsic motives, both intrinsic and extrinsic motives

play a role in determining learner behaviour. The goal is to develop learners who are self-directed and self-motivated, both because the activity is interesting in itself and because achieving the outcome is important. Where intrinsic motivation to learn is the educator's ultimate goal, extrinsic motivators such as cooperation, competition and recognition can and should also be considered when designing learning environments or selecting instructional materials (Malone & Lepper, 1987).

*Cooperation*

Pure cooperation is generally defined as involving a group of individuals working together to attain a common goal (Malone & Lepper, 1987). Many theorists have argued that cooperation should facilitate performance, especially when individuals hold interdependent goals (e.g., Malone & Lepper, 1987). According to Johnson and Johnson (2003), cooperation (compared with competitive and individualistic efforts) promotes greater effort exerted to achieve and greater productivity; more on-task behaviour, higher quality of relationships among participants (e.g., greater interpersonal cohesion, task-oriented and personal support) and greater psychological adjustment (e.g., greater social competencies, higher self-esteem).

Mobile technology can be a tool to deliver one-on-one instruction or serve as a medium for collaboration. Students can learn at their own pace, collaborate with others and offer advice to each other through various apps. Utilizing student-centred activities and apps that match with the curriculum to encourage student collaboration and creativity would create a student-centred, socially interactive classroom; all important skills of the 21st century (Chou *et al*., 2012).

*Competition*

Competition is one of the basic components; competition is a component of many intrinsically motivated 'play' activities. Csikszentmihalyi (1990) stated that achievement motivation (itself a complex of intrinsic and extrinsic motivation) involves competition against a standard of excellence. Competition is usually spoken in terms of two or more people or groups having directly opposing goals. However, Csikszentmihalyi made a similar distinction by differentiating the following two items: 'measuring self against others' (direct competition) and 'measuring self against own ideal' (indirect competition). In indirect competition, the individual or group struggles to perform well against an impersonal standard such as one's best previous performance or the performance norms for one's ability level. Direct competition, however, involves people struggling against one another. Insofar as one plays in order to win, rather than to play well, an extrinsic orientation dominates over an intrinsic one. As one would expect, success led to greater willingness for future participation than failure.

Similarly, when children set out to do a task, they can either proceed with a mastery orientation or a performance orientation (Dweck & Leggett, 1988). Children with a mastery orientation have learning goals – they are concerned with increasing their competence and abilities while mastering new tasks over time. Conversely, children with a performance orientation have performance goals – they are concerned with eliciting positive judgments about their work. There is strong evidence that a mastery orientation can boost children's academic performance, in the short- and long-term. In an experimental study, Dweck and Leggett (1988) manipulated fifth graders' orientation by highlighting either performance goals or learning goals, and by providing feedback indicating either high or low ability on a task. They found that in response to obstacles, mastery-oriented children tended to view challenging situations as an opportunity to acquire new skills or extend their mastery. This response caused them to seek challenges with a positive attitude and high persistence. Performance-oriented children, on the other hand, sought to avoid others' unfavourable judgments. They avoided failure by avoiding risk and difficult/challenging tasks. In response to failure, performance-oriented children were more likely to give up, because they saw failure as evidence of low competence (Dweck & Leggett, 1988). This study aims to describe whether and which of the two competitive forces (direct or indirect competition) and goal orientations (performance or mastery goals) plays a greater role in influencing students' motivation to learn with mobile devices.

*Recognition*

The final kind of intrinsic motivation that can be used in designing instructional environments is recognition (Malone & Lepper, 1987). There is some general agreement among traditional motivational theorists

(e.g., Deci & Ryan, 1985; Malone & Lepper, 1987) that learners enjoy having their efforts and accomplishments recognized and appreciated by others. In order for an environment to engage the motivation for recognition, the results of the individual's activities must be visible to other people (Malone & Lepper, 1987). This can be done in several ways: (1) the process of performing the activity may be visible, (2) the product of the activity may be visible, or (3) some other result of the activity may be visible (Malone & Lepper, 1987).

There is evidence that certain types of technology-enhanced environments provide affordances that support and engender both intrinsically and extrinsically motivated learning (e.g., Malone & Lepper, 1987; Reynolds & Harel Caperton, 2011). That said, this paper aims to describe how the use of mobile devices for classroom instruction relates to the theoretical accounts of what motivates students to learn. Accordingly, the following research question guides this study: What do elementary teachers and students perceive as the motivational affordances of using mobile devices for learning?

## Methodology

### Research design

Qualitative case study methodology (Creswell, 2012) was utilized in order to examine the perceived role of motivation in students' learning with mobile technology. Case studies are undertaken when educational researchers want to derive in-depth understandings of a particular phenomenon that is unique or unusual (Creswell, 2012; Merriam, 2001; Yin, 2003). This particular school is unique because of its geographical setting and the participants' technological expertise and experience. This single-case design was also collective (Stake, 1995) in that it tapped data from different sources, and it was descriptive (Yin, 2003) in that it sought to describe the natural phenomena. This case study aims to use a thick, holistic analysis to describe the perceptions of a grade 6 teacher and her students regarding the motivational affordances of using tablets for learning in their classroom.

### Context of the study

This single-case study is a 3-year SSHRC-funded[1] research project on 21st century reading. This article describes the preliminary Year 1 findings of this longitudinal research study, which was carried out over a 5-month period in a sixth-grade class in a suburban Catholic elementary school in Southern Ontario, Canada. St. Martin Catholic Elementary School (pseudonym used) has a Kindergarten through eighth-grade population of approximately 400 students, with an average family income of $164 000. The school has a predominantly white, upper-to-middle class population with some diversity. The neighbourhood data related to St Martin indicates 13.9% lone parent families, and an unemployment rate of 5.6%. About 4.8% of the residents are recent immigrants, while 22% report a first language other than English or French (Rowsell, McQuirter-Scott, & Bishop, 2013).

### Participants

Natasha, the grade 5 and 6 teacher participant featured in this article, is white, middle class and has been teaching for 7 years [6 of which have been within the Junior Division (Grades 4–6)]. Natasha's class contained 24 students, who ranged in age from 10 to 12 years old. There were 10 boys and 14 girls. Natasha had always been technologically adept and had some understanding of tablets before the study began, but she had not thought about using them for cross-curricular instruction. Technology use in the classroom had been previously limited to desktop computers; however, since participating in this study, Natasha's grade 6 class had regular access to ten tablets which were stored inside a locked cabinet behind Natasha's desk. A team of school district consultants, university faculty, the special education resource teacher and school administration met with Natasha regularly to provide technical, logistical and pedagogical support. Table 1 contains information (gathered through student and teacher interviews) on the demographic characteristics of the ten students who were randomly selected from Natasha's grade 5 and 6 classroom to participate in this study.

As shown in Table 1, participants included four female students and six male students. With the exception of Jeremy, the remaining ten participants owned at least one mobile device at home. The majority of participants stated that they used their mobile devices every day for playing games (apps) such as Angry Birds, accessing social networks (e.g., Facebook),

Table 1. Demographic Characteristics of Grade 5 and 6 Student Participants

| Student | Grade | Gender | Student characteristics | Mobile technology ownership (home) | Mobile technology frequency and purpose of use |
|---|---|---|---|---|---|
| Samantha | 5 | Female | Mid-level reader | iPod, iPhone and iPad | Every day; plays games (e.g., Tap Galaxy, Cut the Rope) |
| Jeremy | 5 | Male | High-level reader | NA | NA |
| John | 5 | Male | Low-level reader | iPad | Every day; plays games (e.g., Minecraft, Angry Birds) |
| Mike | 5 | Male | Low-level reader | iPod | Every day; plays games (e.g., Angry Birds) and text messages to friends |
| Stephanie | 6 | Female | Mid-level reader | iPad and iPod | Some days; plays games (e.g., Angry Birds) and visits social networking sites daily |
| Kathy | 6 | Female | High-level reader | iPod | Every day; reads iBooks; visits social networking sites; plays word games (e.g., Bluster, Whirly Word) |
| Sarah | 6 | Female | High-level reader | iPod Touch and iPad | Some days; email, homework and research, plays games (e.g., Grammar/Word games); visits social networking sites |
| James | 6 | Male | Mid-level reader | iPad | Every day; plays games (e.g., Angry Birds) |
| Mark | 6 | Male | Low-level reader | iPad | Every other day; plays games (e.g., Zombie Farm) |
| Geronimo | 6 | Male | Low-level reader | iPod Touch | Every day; plays games (e.g., Angry Birds) |

video chatting (e.g., FaceTime) and text messaging with their friends (e.g., iMessage). In fact, it was also discovered that several student participants who had access to mobile devices at home downloaded the same educational apps (e.g., Whirly Word, Bluster) that were used in Natasha's classroom.

## Data collection and analysis

This project involved teacher and student interviews, a teacher blog, observational fieldwork and ecological surveys of the community. This article, however, reports only on the information contained in the teacher blog, as well as the teacher and student interviews conducted at the end of the 5-month (Year 1) study.

### *Student and teacher interviews*

At the end of the 5 months, 15 min, semi-structured individual interviews were conducted in order to provide an in-depth understanding of the lived experiences of ten grade 6 students and their grade 6 teacher who used tablets in their classroom. Interviews were selected as a major data collection method, since it enabled the researcher to collect the participants' perceptions regarding the motivational affordances of using these mobile devices for learning. Interview questions focused on the impact of mobile technology use on student learning, motivation and engagement. Although students were more implicitly asked about this aspect of the research through questions of likes and dislikes, teacher interview questions were more specific and included questions such as 'How do you think your students' motivation to learn was impacted by their use of mobile devices in your classroom? How so?'

### *Teacher's blog*

Natasha adopted an action research approach to this study in that she kept a research reflection blog to expand and refine her professional knowledge related to the use of mobile technology in her classroom (by semi-private, we mean that the researchers had access to the website). The inclusion of a semi-private blog as a regular reflection forum helped Natasha to consoli-

date and lift out how tablets affected her lessons. Natasha contributed to the blog regularly (e.g., once or twice a week). The blog was included in this project with the purpose of deepening the understanding or refreshing the teacher's perspective on the phenomenon. Since Natasha shared her experience and thoughts voluntarily in the discussion board without a feeling of 'being investigated', this type of data source might have included her emic issues on this project (Van Manen, 1990).

### Data analysis

All interviews were audio-taped and transcribed by the researcher. Responses to the research question were triangulated from individual semi-structured teacher and student interviews and the teacher's blog. Data analyses consisted of coding and categorizing as described by Creswell (2012). The researchers coded all data independently, meeting subsequently to share individual interpretations and negotiate a shared understanding with any disagreements resolved through discussion until consensus was reached. Student and teacher data were analysed separately at first, and the results were compared to identify commonalities and differences in response patterns. After several readings of the teacher's blog posts and interview transcriptions, the researchers highlighted and coded recurring words, phrases and patterns. The codes represented categories that were in response to the research question. When the coding was complete, the codes were moderated and regrouped them into thematic clusters. The findings presented below were selected data excerpts from the interviews and blog entries that most closely represented Malone and Lepper's (1987) taxonomy of motivations for learning.

## Findings

The overall research question involved: 'How do elementary students and teachers perceive their tablet use and what motivated(s) them to be a tablet user?' As such, the main focus of this study centred on students' and teacher's self-perceptions centring upon their experience with tablet use in the classroom. The findings are presented in clusters that describe the grade 6 teacher's and student participants' self-reported perceptions of the motivational affordances of using mobile technologies in the elementary classroom. Specifically, six categories emerged for the participants as the elements of mobile environments that stimulate intrinsic and extrinsic motivation, which also coincided with those of Malone and Lepper (1987). These categories were challenge; control; sensory and cognitive curiosity; competition, cooperation and recognition.

### Challenge

One of the main findings of this research is that challenge and immediate feedback played a major role in making the mobile apps and games engaging, enjoyable and motivating for the students (Csikszentmihalyi, 1990; Malone & Lepper, 1987). As the students' skill level increased during the game, so did the challenges the student was faced with. Thus, flow was gradually increased over the course of the game in until either the challenge became too great (frustration) or the student's skill outpaced the challenges the game offered (boredom). This occurred to Mark when he first used the tablet; the novelty of the technology and games wore off and boredom began to set in.

> When I first used the tablet I was addicted to it, I played the games and apps on it for at least five hours a day. Now, I am only playing on the tablet for two hours because I got used to it and I beat most of the games (Mark, Grade 6 Student, Interview).

The students and teachers commented that the immediate feedback encouraged many students to keep working on difficult problems, 'There's immediate feedback and they can see where it is that they're struggling or what they need to do to correct it, and normally it gets rectified immediately' (Natasha, Grade 6 Teacher, Interview).

Performance feedback and score keeping also allowed the students to track their progress towards desired goals (to reach the end level of a game), which seemed to stimulate their intrinsic motivation (Malone & Lepper, 1987).

> The games and apps on the tablet push you a lot. For word games like Whirly Word or Bluster, the words get harder and harder and harder on each turn, and that's good because you can't just have easier words all of the time. On some of the apps, we get points and rewards which pushes you a lot. Every time you get a word you have a bar and your bar goes up. You have to try to reach your goal. (John, Grade 6, Interview)

Similarly, Natasha shared an incident where her students had about 10 min to spare before lunch, and they were each given tablets. Much to Natasha's surprise, all of her students chose the common word games they played in class during language arts instruction, including Whirly Word and Bluster. Natasha thought her students would select a non-educational game like Angry Birds. When she asked her students to explain their rationale for choosing the vocabulary games over Angry Birds, they informed her that it was 'more fun playing games they keep getting better at and learning from' (Natasha's blog entry, January 24, 2012).

### Control

Multimedia presentations are more effective when the learner has the ability to interact with the presentation and work at their own pace; when learners are able to control the pace of the presentation, they learn more (Mayer, 2005). Interviews with students confirmed these findings. One of the reported benefits of using tablets in the classroom was that it allowed the students to do tasks at their own pace and placed the locus of control in their own hands. Personalization increased learner's choice where students had greater locus of control (Rudd, 2008). The following quotes illustrate that when students used mobile technology, they were able to personalize their learning experiences in many more ways than would be allowed by paper and pencil or possible during teacher-direction instruction.

> We used a How to Draw app in class, which had numerous artistic videos that anyone can use to draw a face, cartoon character, etc. This app taught us how to draw. I am not one of those people that really enjoy actually drawing, but I liked this because no matter how little your creativity and drawing skills were, it was possible that your drawing could look the exact same as the artist's in the video. So, it really helped. I think it was so easy for me because it gave you step-by-step simple instructions, you could pause the video and there was no rush. Whereas sometimes when the teacher is teaching it, you have some kids falling behind others . . . this was at your own pace. (Samantha, Grade 5 Student, Interview)

> You can read on the tablet at your own pace. You don't have to listen to the teacher talking too fast or too slow for you because if it's too fast, you won't learn anything. If it's too slow you'll just stand there listening to the stuff you already learned. I think people should read at their own pace. They don't have to let teachers read for them. Plus, we're only in grade 6 now . . . we can read by ourselves. (James, Grade 6 Student, Interview)

The smallness of the devices did not seem intimidating to the students. As evident in the following excerpt, the smallness of the technology seems to make some students feel in control, less overwhelmed and more empowered, and thus they were willing to take more risks and expend more energy (Looi *et al*., 2009). According to Natasha, she would not see this same focused activity if the students were all working on other types of technology such as a SMART Board™ which was located at the front of her class.

> My students are not all that impressed with any activity done on the SmartBoard™. I'll have the same game up there that I think they'll really like. But they don't want to do it; they want to do it on their own tablets because everyone else can see what they're doing on the Smartboard™. That's why they don't use our computers in the classroom. But when they're given that opportunity to do that game on the tablet they're happy to do it. They get very shy when it's broadcasted to the whole class, but when they're by themselves, they're ok to give it a try (Natasha, Grade 6 Teacher, Interview)

Nicole also reported that his study reported that the use of the iPod Touch catapulted students into the role of 'teacher' or 'expert' and Nicole into the role of 'novice learner' in immediate and obvious ways. The students' own perceptions of their social experience took on a new dimension when they were the technology experts in the classroom, and some of the teachers were positioned in a novice role. According to Nicole, mobile learning technologies seems to afford learners with more control over their own learning and the ability to access, create and share information across different settings (e.g., home and school; van't Hooft, 2008). As illustrated below, by making personal and relevant connections and bringing her students' own knowledge and experiences to the learning table, Nicole was able to spark her grade 6 students' interest and engagement.

> There is their (the students') world and then there is the world of school. I thought I knew a little bit about their world, but then you say to a group of grade 6 students, 'Do what you would do if you had this at home', and the whole place just lights up they're showing you things that you're going 'Oh my!' (Natasha, Grade 6 Teacher, Interview)

### Sensory curiosity

The multimedia learning principle states that people learn better from pictures and words than words alone; the combination encourages active cognitive

processing and cognitive load reduction to promote deeper learning (Mayer, 2005). Unlike traditional teaching methods that may miss some of these preferred learning styles, the multimedia and interactive capabilities afforded by such mobile devices as the tablet allowed teachers to create multidimensional learning environments which catered to multiple learning styles (e.g., visual, auditory, kinaesthetic) at the same time. The tablet can assist teachers in their effort to personalize instruction according to students' preferred learning styles. The students demonstrated a stronger desire to learn when using the tablet, as they were given the opportunity to interact with information in a way that made sense to them.

> In math, we were learning about patterns and our teacher told us to try a few questions in our math books. Some of us didn't get it. But when we gave us a tablet and we used a Math app with an example of a pattern- a circle, square, circle, square, and it asked 'What's the next pattern?' We'd easily get it. It was really colourful, there were lots of charts, tables, and you could draw what's going on inside of your head on the app. And then it would give you hints and help you figure out the best way. Sometimes technology helps more than someone explaining it to you. (James, Grade 6 Student, Interview)

> There was this one app we used in language arts class.. . . some of us weren't enjoying it because it was too much information. There weren't many pictures. The appearance of the app itself was actually kind of bland. We were looking at a text on our tablets for an hour and a half. The information needs to be a little appealing and not just a plain page . . . a picture or a simple diagram with words and sounds will sometimes help a little more. (Stephanie, Grade 6 Student, Interview)

Touch screen-based devices such as the tablet seemed to provide more freedom to the students in terms of control as compared to print-based texts. The haptic/tactile technology delivered a differentiated, more interactive and personalized user experience, which enhanced their attention (Wong *et al*., 2010).

> One really big difference between reading print texts and reading on the tablet is that on the tablet screen you can increase or decrease the font size, so it's easier for you to read on the tablet. For some people with glasses, they either have to put the book far away or really up close. But instead of using all that arm power, you could just easily zoom in or zoom out on the screen. (Stephanie, Grade 6 Student, Interview)

> I did find that when I would ask my students after they worked on the iBrainstorm app, they found it better than just putting it down on paper. Using the virtual sticky notes, changing the colour of the sticky notes and moving and rearranging the notes on the screen . . . who knew such a subtle little thing could make a reading and writing activity that much more exciting?! (Natasha, Grade 6 Teacher, Interview)

**Cognitive curiosity**

By enabling learners to learn 'anytime, anywhere', mobile technology augments the propensity for students to engage in self-directed, informal learning beyond the classroom walls (Sharples, Taylor, & Vavoula, 2007). As shown in the excerpt below, Kathy viewed mobile technology as a tool for bridging school learning and home learning as she engaged in learning that was both spontaneous and deliberate (Sharples *et al*., 2009).

> I was just searching the app store on my own time, because I like doing that every other week to see what new games are on the charts. We were doing an advertising unit in class, and I found an app under the school section in the app store. It was a logo quiz. What you had to do was you have logos and then you had to match them with the name and then you had to say what they sell/services, and it really made me think cause it kind of helped me with my homework. I enjoyed it; I went through all the levels, too. (Kathy, Grade 6 Student, Interview)

According to Sarah, the tablet was her preferred device because of its convenience and ease-of-use.

> It's very easy to get from one app to another, and it's easier to start an Internet browser. The tablet is very convenient and very easy to understand because sometimes when you're on a laptop, there are certain things that pop up like advertisements. There's nothing that pops up on a tablet. And I really like that on the tablet, if there's a word that you don't know then you can figure out really easily what that word means. Whereas with the book, you have to read it all over again, and still don't know what it is, so you have to get up and get a dictionary, look it up, which takes a while and it's harder. (Sarah, Grade 6 Student, Interview)

Similarly, Jeremy preferred the tablet to printed materials because of the speed of access to updated and current information, which may have increased his intellectual curiosity.

> The textbooks I've noticed are not updated, they're old and most of the time our teachers say 'Oh don't look at

> that graph or diagram, it's behind 10 years' so I'd rather be reading stuff on the tablet that's recent and not stuff that's older and getting wrong information. (Jeremy, Grade 5 Student, Interview)

Students reportedly enjoyed the fact that the tablet presented them with a wealth of media choices and an instantaneous wealth of information available to them at their fingertips (Sharples, 2007). 'It's really unlimited what we can do with the tablet. For example, I really enjoy the iBooks on the tablet because you can find any book; whereas in our library, there isn't as much variety and choices' (Sarah, Grade 6 Student, Interview).

Thus, mobile technology may have played a role in cultivating students' curiosity by providing greater and easier access to a wealth of new information (Jenkins, Clinton, Purushotma, Robison, & Weigel, 2006).

**Competition**

Consistent with previous research (e.g., Deci & Ryan, 1985; Deci *et al.*, 1981), Natasha and her grade 6 students perceived the tablet as supporting mastery-oriented evaluation rather than performance-oriented evaluation. As illustrated below, Natasha strived to create a mobile learning environment that emphasized mastery over performance, where success was defined as increasing one's own competence rather than outperforming others (Dweck & Leggett, 1988). In this case, competition was perceived as enhancing intrinsic motivation by providing optimal challenge and ongoing feedback (Malone & Lepper, 1987).

> I directed them to Math Edge where they completed 50 questions at a time. The app gave them the amount of time it took to complete all questions, so I suggested they see if they could better their time, and all of a sudden the challenge was the reward. Every student felt successful and was eager to beat their best time. We played for 20 min and every pair improved their score by half. There was a real excitement because something hard-learning multiplication facts-became achievable and the kids recognized immediately that something important had just happened. The satisfaction of learning was much more rewarding than the Ninjas (from the Math Ninja app), and they were able to articulate that! (Natasha, Grade 6 Teacher, Blog Entry, April 15, 2012)

**Cooperation**

The tablet can be instrumental in creating inclusive learning environments that engage all students regardless of ability, disability, background or learning style (Wellings & Levine, 2009). This was confirmed by Natasha, who believed that the integration of mobile technology into her classroom fostered inclusion. The tablets seemed to remove the barriers to learning, put all children on a level playing field and engaged diverse learners in activities that otherwise may have been impossible or even avoided using traditional methods (Looi *et al*., 2009).

> Before the Grade 6's started using the tablets, they couldn't get Lisa (a Grade 6 student) to work with other people because she was just refusing and wouldn't do it. She was always very anti-social. She hated all sorts of technology. But she loves the tablet, just from what she's found she can do with it. She likes it because it's more user-friendly, its smaller, she can carry it around. She recently worked on a Tunetastic video with one of the higher students in the class using the tablet. She's one of the lower students, and you wouldn't know it just from the work that they created. Her peers were like, 'Wow, you're really good at acting!' So that built her confidence, and they were showcased it in front of her class. Now wants to use the tablet for a lot of things and is looking at technology. She also hated reading and writing, she can't read very well . . . but now she has the tablet read to her, and she knows how to highlight text. So, she's really learned a lot from the other student as well, and has also taught the other student how to use the tablet and knows the features more than the brighter student. (Natasha, Grade 6 Teacher, Interview)

The use of mobile technology markedly improved learning outcomes and promoted greater motivation to persist on tasks. Students in cooperative learning groups engaged in more positive, task-oriented interaction with each other. The following quote highlights the affordances of a technology-enriched classroom where such practices as (cross-age) peer mentoring and reciprocal teaching is fostered.

> I will put a grade 5 with a grade 6 or a higher or lower level and they get so excited when they get to do that, because very rarely do they get to do things together and they want to be together all the time, so it's a good comradery. (Natasha, Grade 6 Teacher Interview)

The use of mobile technology in Natasha's classroom markedly improved student learning outcomes and promoted greater motivation to persist on tasks.

The students in cooperative learning groups seemed to engage in more positive, task-oriented interaction with each other.

### Recognition

Satisfaction is necessary for learners to have positive feelings about their learning experiences and to develop continuing motivation to learn (Maehr, 1976). This means that extrinsic reinforcements, such as rewards and recognition, must be used in accordance with established principles of behaviour management (Skinner, 1968). As mentioned earlier, in order for an environment to engage and motivate the student, the results of one's activities must also be visible to other people (Malone & Lepper, 1987). The following quote highlights what transpires in Vygotsky's (1978) zone of proximal development, as students were teaching each other how to use the tablet and showcasing their creative work. According to Natasha, the mobile technology was also an outlet for some of her quieter students to overcome their shyness, become engaged, which led to improved participation.

> Yesterday my students were using this app for the first time in preparation of creating story boards for an upcoming digital comic strip they will be creating. Once completed, students presented their ideas to the class and were overjoyed to share them with everyone. I am still so pleased and surprised to see how excited and confident they are to use the tablet and its capabilities. It allows my quieter kids to have a platform to shine. (Natasha, Grade 6 Teacher, Blog Entry, April 11, 2012)

## Discussion

This paper extends previous work by Malone and Lepper (1987) and applies their theoretical approach in a new context for learning in terms of how mobile devices motivate students to learn. We identified six key aspects of successful (mobile) learning systems: challenge, control, curiosity, recognition, cooperation and competition.

The importance of appropriate challenge cannot be overstated. In accordance with Malone and Lepper's (1987) taxonomy of intrinsic motivations for learning, this study discovered that such motivational aspects as optimal challenge (against oneself) and immediate feedback were incorporated into the mobile apps used in Natasha's grade 5 and 6 classroom. This type of learning honours choice in activities, allows for self-paced learning and publicly acknowledges achievement by providing almost instant feedback. In traditional classrooms where quizzes and assignments are graded by hand, students may not find out how they have done until long after a concept has been taught; consequently, some students may lose interest and have little incentive to complete these activities (Brophy, 2010). On the contrary, the quizzes and games available on the mobile apps provided opportunities for repeated student self-assessment and instant feedback (correct or incorrect answer along with their completion time). Natasha and a majority of student participants found the instant feedback to student responses was useful and an especially appealing form of incentive for the students which encouraged many of them to keep working on progressively more difficult problems and scaffolded challenges provided by the mobile apps. Natasha welcomed the fact that she could track each student's progress, understand the strengths and weaknesses of individual students, and refine their teaching. The interactivity and automatic feedback features of these tablet apps may have also contributed to heightened cognitive curiosity and students' voluntary use of these same educational apps at home.

According to Howard Gardner (1999), seven kinds of intelligence allow seven ways to teach, rather than one. Natasha's mobile multimodal classroom built on Gardner's insight by letting students learn at their own pace (learner control) and enhanced their sensory curiosity (Malone & Lepper, 1987). Alongside this, the tablets provided built-in means of differentiated learning experiences that otherwise may have been impossible using monomodal, traditional methods (Looi *et al*., 2009). Videos and iBooks available on the tablet gave students control over aspects of their learning where they can listen and view the instructional information repeatedly at their own pace (McKinney, Dyck, & Luber, 2009).

Traxler (2007) states that 'mobile learning delivers learning to the learner when and where they want it' (p. 7). In other words, mobile device use augments the propensity for students to engage in self-directed learning and stimulate their cognitive curiosity beyond the classroom walls (Traxler, 2007). Consistent with previous research (e.g., Sharples *et al*., 2009; Traxler, 2007), the findings of this research illustrate how mobile devices were viewed as a tool for bridging school learning and home learning. The portability and convenience of mobile devices emerged as determining

factors in students' decisions to use them actively for leisure and social networking purposes, as well as formally and informally to support their schoolwork (Low & O'Connell, 2006; Malone & Lepper, 1987).

Numerous studies on computer-supported cooperative learning have also demonstrated positive effects on the amount and quality of social interaction (e.g., Fishman & Gomez, 1997). The concept of cooperative learning is based on a social learning theory that students are more likely to possess high self-efficacy, confidence, and have higher motivation to complete a task when they know they will have assistance from their peers (Cheng & Ku, 2009). Cooperative learning was enhanced in Natasha's grade 5 and 6 classroom by the use of mobile devices. Consistent with previous research, Natasha's students worked cooperatively with technology and some even held more positive attitudes, improved intergroup relations and increased acceptance of academically challenged peers (Cheng & Ku, 2009). Cooperative learning resulted in supportiveness for partners and increase in helping behaviours. These practices also helped many students overcome their shyness and led to improved participation. The use of the tablet removed the barriers to learning, put all children on a level playing field and engaged these diverse learners in activities that otherwise may have been impossible or even avoided using traditional methods (Looi *et al*., 2009).

Vygotsky's (1978) zone of proximal development (ZPD) can also be used to explain this finding. According to Vygotsky's social constructivist theory, learning is a socio-culturally mediated and collaborative process that occurs through interactions and sharing with others, including teachers, parents and other learners (Vygotsky, 1978). More specifically, Vygotsky's theory of the ZPD which accentuates the supportive guidance of mentors and 'experts' (usually but not exclusively teachers), as they enable the novice learner to achieve successively more complex skill, understanding, and ultimately independent competence. However, rather than focus on the adult as the more capable other who mentors the younger student, this finding looks at the ZPD from the vantage point of the student being the more capable other. Natasha reported that the use of the tablets in her classroom catapulted students into the role of 'teacher' or 'expert' and teachers into the role of 'novice learner' in immediate and obvious ways. The students' own perceptions of their social experience took on a new dimension when they were the technology experts in the classroom, and Natasha was positioned in a novice role. Natasha was pleasantly relieved to find that she was participating in reciprocal teaching methods as her students were teaching her about the capabilities of the tablet and some apps. These findings highlight the shifting dynamics in a technology-enriched classroom where such practices as (cross-age) peer mentoring, reciprocal teaching and student-teacher role reversals are fostered.

Whether competing for grades in classrooms or trophies in athletic contests, individuals may view their behaviour as externally controlled and experience pressure to win (direct competition; Malone & Lepper, 1987). On the other hand, indirect competition can lead individuals to view activities as challenging and opportunities for immediate feedback, making competition attractive to some individuals. Consistent with earlier findings (e.g., Reeve & Deci, 1996), the latter form of competition seemed to play a greater role in influencing students' motivation to learn with the tablet. The mobile apps used in Natasha's grade 5 and 6 classroom provided a personalized learning experience and fostered indirect competition where students strived to beat their own previous best performance (mastery orientation) by completing a series of self-selected quests.

## Implications

Although much has been said about the inherent motivating qualities of mobile technology; generally, there is a paucity of research that directly reflects the connection between mobile technology use and the role of motivation in learning with mobile technology. What are the motivational affordances of using these mobile devices for learning? This is the pivotal question we sought to address in this paper. The results of this study indicate that Malone and Lepper's (1987) taxonomy of intrinsic motivations for learning can be applied to mobile learning. The taxonomy described in this paper provides a model of how to design intrinsically motivating mobile (and non-mobile) learning environments.

In this study, students identified teamwork and opportunities to work with other students as important motivational factors. It is in these venues that individuals can share thoughts and ideas and become active participants in a digital society and develop the skills of cooperation and collaboration. As with any learning experience, providing a scaffold experience can help

develop the individual. Teachers and mobile developers may be able to facilitate the development of the interpersonal skills required for teamwork by grouping students heterogeneously – mixing students of different ability levels and grades – and suggesting roles for group members (e.g., typer, recorder, reader, time keeper, checker for understanding), as well as providing students time to analyse and discuss how effectively they are working together and how they may work more effectively together in the future.

Especially for struggling learners, there is a need for a 360-degree approach to learning, in which the experiences that underlie in-school learning are aligned with those in afterschool and home settings (Shore, 2008). Anchoring instructional lessons for the 21st century classroom can be viewed as an intimidating task, especially considering that many students are more technologically engaged outside of school than inside their classrooms (Walker & Shepard, 2011). One way to harness student motivation is by allowing and encouraging students to utilize their technical knowledge and experiences and allow them to engage in self-directed learning activities.

When compared to the wide range of technologies at our disposal, the highly personalized nature of mobile devices provides an excellent platform for the development of personalized, learner-centric educational experiences marked by flexibility, customization, collaboration, active participation and co-creation (Looi *et al*., 2009). Most importantly, mobile learning gels with constructivist principles where multiple learning pathways and scaffolding activities can be constructed, and knowledge can be explored in multiple ways and in multiple contexts that best resonates with the needs of the users (Looi *et al*., 2009). When learning with mobile devices is carefully designed, it is possible to create more collaborative and participatory learning experiences while increasing pupil engagement and mastery of important concepts (West, 2012).

The theoretical approaches that appear to be most relevant to mobile learning are those that involve learner control and challenge by setting an appropriate level of complexity, provoke their user's curiosity, and allow them to engage in active learning conversations. Teachers should also help children develop a mastery orientation to learning, which holds great promise for improving academic achievement. To influence children's mastery orientation towards learning, teachers should provide tasks that are meaningful to children, given their interests and environments; place the emphasis on mastery of the skill, rather than performance; and focusing on the value of learning (and what can be gained) in formal and informal evaluations. Building these concepts into mobile apps and activities designed for mobile learning will support and motivate future learners.

### Limitations of the study

This case study has some limitations that need to be considered when interpreting the findings above. Limitations from this study stem from its scope, particularly the size and composition of the sample population and lack of a control group. There is a need for future empirical research with a larger and more varied sample to clarify the present findings and examine the connection between motivation and learning outcomes.

As with any technology that is introduced in a learning environment, there is always a novelty effect (Krendl & Clark, 1994). Students tend to be more motivated to use a new piece of technology for learning because it is new. The implication of this criticism is that the positive outcomes learning from the new medium, having more positive attitudes about learning will tend to decline as the technology becomes more familiar and its novelty wears off. Future studies on mobile technology should include more longitudinal research to determine whether motivation to use mobile technology and levels of mobile technology use change over a longer period of time. Designers and teachers will also need to explore what steps can be taken to combat the 'novelty effect' in order to achieve sustained motivation, one of which may include creating difficulty levels that will keep the player in flow for as long as possible.

In sum, a better understanding of the nature of intrinsic and extrinsic motivation and the ability to gauge students' motivation while interacting with mobile technology-supported learning environments promises to contribute to the design of more effective educational programs and thus ultimately to higher educational performance.

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## References


Beck, J. C., & Wade, M. (2006). *The kids are alright: How the gamer generation is changing the workplace*. Boston, MA: Harvard Business School.

Beishuizen, J. (2008). Does a community of learners foster self-regulated learning? *Technology, Pedagogy and Education*, *17*, 183–193.

Brophy, J. (2010). *Motivating students to learn* (3rd ed.). New York, NY: Taylor & Francis.

Cheng, Y. C., & Ku, H. Y. (2009). An investigation of the effects of reciprocal peer tutoring. *Computers in Human Behavior*, *25*, 40–49.

Chou, C. C., Block, L., & Jesness, R. (2012). A case study of mobile learning pilot project in K-12 schools. *Journal of Educational Technology Development and Exchange*, *5*(2), 11–26.

Creswell, J. W. (2012). *Educational research: Planning, conducting, and evaluating quantitative and qualitative research* (4th ed.). Boston, MA: Pearson Education.

Csikszentmihalyi, M. (1990). *Flow: The psychology of optimal experience*. New York, NY: Harper Collins.

Deci, E. L., Betley, G., Kahle, J., Abrams, L., & Porac, J. (1981). When trying to win: Competition and intrinsic motivation. *Personality and Social Psychology Bulletin*, *7*, 79–83.

Deci, E. L., & Ryan, R. M. (1985). *Intrinsic motivation and self-determination in human behavior*. New York, NY: Plenum.

Dornyei, Z. (2000). Motivation in action: Towards a process-oriented conceptualization of student motivation. *British Journal of Educational Psychology*, *70*, 519–538.

Dweck, C. S., & Leggett, E. L. (1988). A social-cognitive approach to motivation and personality. *Psychological Review*, *95*, 256–273.

Evans, M., & Johri, A. (2008). Facilitating guided participation through mobile technologies. *Journal of Computing in Higher Education*, *20*, 92–105.

Fishman, B., & Gomez, L. (1997). How activities foster CMC tool use in classrooms. In R. Hall, N. Miyake, & N. Enyedy (Eds.), *Computer support for collaborative learning* (pp. 37–44). Toronto, CA: Erlbaum.

Gambrell, L. B. (1996). Creating classroom cultures that foster reading motivation. *The Reading Teacher*, *50*(1), 14–25.

Gardner, H. (1999). *Intelligence reframed: Multiple intelligences for the 21st century*. New York, NY: Basic Books.

van't Hooft, M. (2008). Envisioning the future of education: Learning while mobile. *Learning and Leading with Technology*, *35*(6), 12–16.

Jenkins, H., Clinton, K., Purushotma, R., Robison, A. J., & Weigel, M. (2006). *Confronting the challenges of participatory culture: Media education of the 21st century*. Chicago, IL: The MacArthur Foundation.

Johnson, D. W., & Johnson, R. (2003). Student motivation in cooperative groups: Social interdependence theory. In R. Gillies & A. Ashman (Eds.), *Cooperative learning: The social and intellectual outcomes of learning in groups* (pp. 136–176). New York, NY: Routledge Falmer.

Joiner, R., Nethercott, J., Hull, R., & Reid, J. (2006). Designing educational experiences using ubiquitous technology. *Computers in Human Behavior*, *22*, 67–76.

Klein, J. D., & Keller, J. M. (1990). Influence of student ability, locus of control, and type of instructional control on performance and confidence. *Journal of Educational Research*, *83*(3), 140–146.

Krendl, K. A., & Clark, G. (1994). The impact of computers on learning: Research on in-school and out-of-school settings. *Journal of Computing in Higher Education*, *5*, 85–112.

Lepper, M. R., & Cordova, D. I. (1992). A desire to be taught: Instructional consequences of intrinsic motivation. *Motivation & Emotion*, *16*, 187–208.

Liu, M., Toprac, P., & Yuen, T. (2009). What factors make a multimedia learning environment engaging: A case study. In R. Zheng (Ed.), *Cognitive effects of multimedia learning* (pp. 173–192). Hershey, PA: Idea Group Inc.

Looi, C. K., Wong, L., Hyo-Jeong, S., Seow, P., Toh, Y., Chen, W., . . . Norris, C. (2009). Anatomy of a mobilized lesson: Learning my way. *Computers & Education*, *53*, 1120–1132.

Low, L., & O'Connell, M. (2006). *Learner-centric design of digital mobile learning*. Paper presented at Learning on the Move, Brisbane, Australia.

Maehr, M. L. (1976). Continuing motivation: An analysis of a seldom considered educational outcome. *Review of Educational Research*, *46*, 443–462.

Malone, T. W., & Lepper, M. R. (1987). Making learning fun: A taxonomy of intrinsic motivations for learning. In R. E. Snow & M. J. Farr (Eds.), *Aptitude, learning, and instruction: III. Conative and affective process analyses* (pp. 223–253). Hillsdale, NJ: Erlbaum.

Mayer, R. E. (2005). *Cambridge handbook of multimedia learning*. New York, NY: Cambridge University Press.

McKinney, D., Dyck, J. L., & Luber, E. S. (2009). iTunes university and the classroom: Can podcasts replace professors? *Computers and Education*, *52*, 617–623.

Merriam, S. B. (2001). *Qualitative research and case study applications in education: Revised and expanded from case study research in education* (2nd ed.). San Francisco, CA: Jossey-Bass.

Norris, C., & Soloway, E. (2008). An instructional model that exploits pervasive computing. In J. Voogt & G. Knezek (Eds.), *International handbook of information technology in primary and secondary education* (pp. 849–860). New York, NY: Springer.

Quinn, C. N. (1994). Designing educational computer games. In K. Beattie, C. McNaught, & S. Wills (Eds.), *Interactive multimedia in university education: Designing for change in teaching and learning* (pp. 45–57). Amsterdam, The Netherland: Elsevier.

Reeve, J., & Deci, E. L. (1996). Elements of the competitive situation that affect intrinsic motivation. *Personality and Social Psychology Bulletin*, *22*, 24–33.

Reynolds, R., & Harel Caperton, I. (2011). Contrasts in student engagement, meaning-making, dislikes, and challenges in a discovery-based program of game design learning. *Journal of Educational Technology Research and Development*, *59*, 267–289.

Rowsell, J., McQuirter-Scott, R., & Bishop, A. (2013). Tablets as placed resources: Community literacies in global domains. *Language Arts*, *90*, 351–360. Special issue edited by R. Rogers.

Rudd, T. (2008). *Learning spaces and personalisation workshop outcomes*. Bristol, UK: NESTA Futurelab. Retrieved from http://www.futurelab.org.uk/resources/documents/event_presentations/Learning_Spaces_and_Personalisation_workshop.pdf

Shaffer, D. W. (2006). *How computer games help children learn*. New York, NY: Palgrave Macmillan.

Sharples, M. (Ed.). (2007). *Big issues in mobile learning: Report of a workshop by the Kaleidoscope Network of Excellence Mobile Learning Initiative*. Nottingham, United Kingdom: Univeristy of Nottingham, Learning Sciences Research Institute.

Sharples, M., Arnedillo-Sánchez, I., Milrad, M., & Vavoula, G. (2009). Mobile learning: Small devices, big issues. In S. Ludvigsen, N. Balacheff, T. D. Jong, A. Lazonder, & S. Barnes (Eds.), *Technology-enhanced learning: Principles and products* (pp. 233–249). Berlin, Germany: Springer-Verlag.

Sharples, M., Taylor, J., & Vavoula, G. (2007). A theory of learning for the mobile age. In R. Andrews & C. Haythornthwaite (Eds.), *The Sage handbook of e-learning research* (pp. 221–247). London, UK: Sage.

Shore, R. (2008). *The power of Pow! Wham!: Children, digital media & our nation's future. Three challenges for the coming decade*. New York, NY: The Joan Ganz Cooney Center at Sesame Workshop.

Shuler, C. (2009). *Pockets of potential: Using mobile technologies to promote children's learning*. New York, NY: The Joan Ganz Cooney Center at Sesame Workshop.

Skinner, B. (1968). *The technology of teaching*. New York, NY: Appleton-Century-Crofts.

Stake, R. E. (1995). *The art of case study research*. London, UK: Sage.

Traxler, J. (2007). Defining, discussing, and evaluating mobile learning: The moving finger writes and having writ. . . . *The International Review of Research in Open and Distance Learning*, *8*(2), 1–12.

Turner, J. C. (1995). The influence of classroom contexts on young children's motivation for literacy. *Reading Research Quarterly*, *30*, 410–441.

Valk, J. H., Rashid, A., & Elder, L. (2010). Using mobile phones to improve educational outcomes: An analysis of evidence from Asia. *The International Review of Research in Open and Distance Learning*, *11*, 117–140.

Van Manen, M. (1990). *Researching lived experience: Human science for an action sensitive pedagogy*. London, ON: Althouse.

Vogel, D., Kennedy, D. M., & Kwok, R. (2009). Does using mobile device applications lead to learning? *Journal of Interactive Learning Research*, *20*, 469–485.

Vygotsky, L. S. (1978). *Mind and society: The development of higher mental processes*. Cambridge, MA: Harvard University Press.

Walker, L. R., & Shepard, M. F. (2011). Phenomenological investigation of elementary school teachers who successfully integrated instructional technology into the curriculum. *Journal of Educational Research and Practice*, *1*(1), 23–35.

Wellings, J., & Levine, M. H. (2009). *The digital promise: Transforming learning with innovative uses of technology*. New York, NY: Joan Ganz Cooney Center at Sesame Workshop.

West, D. M. (2012). *Digital schools: How technology can transform education*. Washington, DC: Brookings Institution Press.

Wong, C. Y., Chu, K., Khong, C. W., & Lim, T. Y. (2010). *Evaluating playability on haptic user interface for mobile gaming*. Paper presented at the Information Technology International Symposium, 15–17 June, Kuala Lumpur, Malaysia.

Yin, R. K. (2003). *Case study research: Design and methods* (3rd ed.). Thousand Oaks, CA: Sage.