Perspectives on Rethinking and Reforming Education

Shengquan Yu
Mohamed Ally
Avgoustos Tsinakos *Editors*

Mobile and Ubiquitous Learning

An International Handbook

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Foreword

Advances in access to mobile technologies have been phenomenal in recent years. The UNESCO Web site reports that there are currently more than 1.75 billion smartphone users in the world, and over 6 billion people have access to a connected mobile device. For every three persons who access the Internet, two will do so from a mobile device. Such developments provide up-to-now unheralded connectivity and support various forms of interactions among people, as well as enable access to digital resources. They are transforming the technological landscape for living, work, play, and learning.

In the area of learning and education, mobile technologies enable learning anywhere and anytime. When mobile technologies are ready-at-hand as well as ubiquitous, there are more opportunities for learners to access, share, and construct knowledge readily in different settings and modes. Indeed, there is uniqueness in mobile and ubiquitous learning which makes it stand apart from access to traditional learning from desktop-bound computers. Informed by the fields of the learning sciences, educational psychology, and educational technologies, designers of learning can make use of such affordances, or design new affordances to create learning and instructional spaces, scenarios, tasks, and experiences that foster deep and meaningful learning.

Mobile learning can be happening in formal spaces of learning, or in informal spaces which are outside of the formal spaces. It can also integrate aspects or episodes of informal learning with formal learning, creating opportunities for seamless learning. Ubiquitous learning provides a notion of learning which is motivated or enabled by the mobility, ubiquity, and contextual awareness of digital and networked technologies. In ubiquitous learning, learners leverage on the pervasive and embedded technologies around us. Mobile learning enables learning in context with awareness of the context detected and supported by location-based and other sensor-based technologies.

While there is a lot of promise and potential in mobile and ubiquitous learning, this field is still very much understudied and undertheorized. The challenge for research is to develop these designs of learning, and use them to study mobile learning—what works and how it works—so as to provide an evidence base

of theories, designs, and implementation challenges of mobile learning. In terms of implementation, there is still much ground to cover in terms of lowering the barriers to adoption, sustained use in learning practices, and scaling up. Mobile usage in everyday life is rife, but mobile usage for learning can still go a long way.

This book is a timely contribution on some of the latest research and development areas and trends for mobile and ubiquitous learning. The chapters focus on demonstrations and discussions of new designs and developments in the field of mobile and ubiquitous learning. There are chapters that share work on advances in technologies like wearables, and virtual and augmented realities for learning; advances in analysis methods like social network analysis; the application of mobile technologies in formal and informal learning; and implementation and ethical issues; and even a chapter that take in traditional psychological constructs like mindfulness and recontextualize them in a mobile learning context. The chapters provide a platform to readers elucidating current research work from taking some of these ideas to apply to building upon in their own research pursuits. The space of possibilities for enhancing or disrupting learning ecologies has never been greater than at any other point in human history. This book will prompt us to reflect on what this collection of research studies done internationally has informed us on where we are now in this journey of designing and implementing designs of mobile and ubiquitous learning.

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Contents

Introduction

The smart phone has penetrated almost each of the societal sectors; from professionals, amateurs, consultants, tourists unto parents and children. In some countries, schools are one of the few places where in many cases the mobile phone has been abolished. Two explanations are as follows:

1. Learning is a vulnerable process; a process that easily suffers from distraction and sensation seeking.
2. Teachers hesitate on how the smartphone can help the learning process; essentially, they feel the threat of giving up the long tradition of expository teaching

The first explanation starts to become obsolete as more and more we accept the value of "Learning by Playing." Playing exceeds the potential of Gaming; Gaming aims at winning, while Playing is the absolute intrinsic motivation; the object of learning by playing is to satisfy a certain immersion and benefits from an altruistic mindset. In learning by playing, the learner likes a certain context, object, motoric skill, and convention on how to master, predict, and understand. In contrast, learning by being taught is the trust that following the preferred path is the shortest route to master a test. The chapters before you offer clear rationales why learning will always jump on new vehicles like recently the smartphone, new coming video games, immersive 3D virtual reality, learning analytics based upon big data, social media, MOOCs (Massive Open Online Courses), and the Web-based platforms for allowing teachers to share expertise and learning materials.

More essential is the latest trend to vitalize education by integrating societal themes in schools. From primary education until university-level curricula, this trend is clear; young people do not accept the certificate as incentive for sacrificing attention and time during their precious early years. As emerging theme, we see the thematic strand of sustainability, both ecological and societal and economical (fair trade) that "make youngsters tick."

In summary, we can say that media technology has worked out as catalyst in educational innovation; not only the access methods, contents, and assessment

conventions have developed quickly; it is the teasing question "What values do we want to target in education?"

We will soon see that education can no longer escape from including ideology in adolescents' development; knowledge without value rationale is brittle and powerless.

May this book inspire you to transit the border from regarding education as societal-relevant rather than just intellectual. This book will make a difference in readers' thinking about the coming twenty-first-century skills, attitudes, and missions.

Dr. Piet Kommers
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Part I
Theoretical Foundation

Chapter 1
Mobile Digital Games as an Educational Tool in K-12 Schools

Helen Crompton, Yi-Ching Lin, Diane Burke and Alana Block

Abstract Games are one of the most elemental and basic of human activities that interest people of all ages. Mobile digital games can be used as a beneficial educational tool to enhance teaching, promote student learning, achievement, growth, and development as well as to cultivate students' twenty-first century skills. The aim of this chapter is to discuss how educators can use digital gaming as an instructional tool in their classroom, regardless of age level or subject area, and thus transform their students into active participants and increase their student achievement levels. This paper examines core aspects of digital gaming, the benefits of digital gaming as well as its limitations such as the challenge of determining the appropriate technology to align with pedagogy and age level. Suggestions are offered as to how the issues can be addressed and concluded with implications for future study.

Keywords Game-based learning · Digital games · Mobile digital games Technological games · Digital gaming · Educational tools

Digital games can be used as educational tools to enhance teaching and learning in K-12 schools. Mobile digital games have become the way for young people to communicate and make connection to the world; therefore, educators have started to introduce mobile digital games to support teaching and learning in classrooms which provide students meaningful learning experiences (Parks, 2008). To achieve optimal success in learning outcomes, educators need to constantly evaluate their instructional practices, tools, and resources (Panoutsopoulos & Sampson, 2012). For instant, research shows that mobile games are beneficial for children's development and academic achievement. It is important for educators and researchers to evaluate and recognize the potential of using mobile digital games to engage learners in multi-sensory and complex learning processes (Parks, 2008).

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The Federation of American Scientists (2006) reports digital games have several features attracting educators including higher-order thinking skills, scaffolding, and contextual bridging (Scientists, 2006). Mobile digital game-based learning (MDGBL) can also be tailored to fit the goals of the curriculum and the needs of the learner in different subject area. According to Deubel's study (2006), mobile digital game-based learning (a) provides deep engagement, (b) offers motivation for persistence in learning, (c) enables customized learning experiences, and (d) promotes long-term and working memories. Furthermore, mobile digital gaming can work interdependently to foster and encourage student learners to actively engage in academic learning as well as develop critical twenty-first century skills that are imperative for real-world success. An efficient and well-designed mobile digital game-based learning could enhance learners' planning and problem solving, expand vocabulary, improve mental agility (Clark, Tanner-Smith, & Killingsworth, 2016), improve computer fluency (Deubel, 2006), and develop eye–hand coordination (Drew & Waters, 1986). Other findings from a systematic review from K-16 students show that digital game-based learning approaches significantly enhance students' learning beyond nongame-based learning approaches. The effects of using mobile digital game-based learning were crossed visual, narrative, and quality characteristics of learning mechanics (Clark et al., 2016). More importantly, mobile digital learning environment provides opportunities to reach different needs of many diverse learners (Kim, Mims, & Holmes, 2006).

This chapter provides a brief review of history of mobile digital game-based learning, its essential features, and its benefits in different subject areas. Researchers also focus on examining mobile digital games to be utilized in K-12 classrooms to help students' success in different subjects.

1.1 History of Mobile Digital Game-Based Learning

Games are an integral part of peoples' lives (Stramel, 2016), and they are one of the oldest human activities in the world (Grove & Schaller, 2007). Playing games is not a new concept (Annette, 2008; Grove & Schaller, 2007), but also it is a period for children to master the structure of the surrounding world. Older children and adults are continually using games to entertain and educate themselves. Therefore, mobile digital games should be good educational tools implemented in the classroom (Annette, 2008). Mobile digital game-based learning became popular in the last decades of the twentieth century while a global technology booming. Newer generational learners are digital natives as they have experienced their entire life with the ability to access and utilize technology such as video games, mobile phones, and tablets. Prensky suggested that contemporary learners think and process information fundamentally differently than digital immigrants; therefore, teachers from digital immigrants' generation should learn how to adapt digital natives learning styles

(Coffey, 2009; Prensky, 2001). Teachers and educators must constantly review their instructional practices so that they are not obsolete. Thus, being aware of the dramatically beneficial digital games could impact students learning.

1.2 Essential Features of Mobile Digital Games for Learning

Deubel's (2006) study categorized games into action, adventure, fighting, puzzle, role playing, sports, and strategy types. Mobile digital games can be as simple or complex depending on the educational goals; therefore, teachers must have clear goals of using mobile digital games. For instance, *Food Force*, developed by the United Nations World Food Program in 2005, is mainly to put players in a famine-affected country learning context. The goal for player is to recover from famine and become a self-sufficient country again. This game could help players develop deep understandings of complex and dynamic systems and then use logic, memory, problem-solving skills to reach goals. Those skills which learners will develop are needed to be successful in twenty-first century (Annette, 2008). Because each game has different goals and purposes for different types of learners, choosing appropriate digital games should take into considerations a range of factors including learners' characteristics (i.e., age, gender, and competitiveness, and previous gaming experience), learners' special needs, and number of players. The role of teacher in the game is also important to take into consideration when choosing digital games.

Mobile digital games for learning also must have clear rules including choice and chance elements to let stronger to weaker learners have a chance to win such as *Shoots and Ladders* virtual digital game. Specifically, rules are built underlying model structure in accordance with cognitive objectives. Stramel suggested that teacher should understand the model behind the game and explain various strategies for learners (Stramel, 2016). Furthermore, games should allow learners to record data for revisiting and reflecting what they have learned. Teachers could use questions and prompts to render learners reflecting what they learned from a game. For instant, teachers could ask learners the following questions: "What is the most important aspect about mathematics you learned from this game? What strategy did you use to help you to play this game? What was tricky about this game? Can you connect the math that you learned in this game to something you learned in class? How is this knowledge useful outside the classroom? What was the most fun thing about the game? How did you feel when you played the game? What were your strengths when playing the game? What advice would you give to someone to play the game in the future?". Researchers suggested that the reflection process is a crucial element of allowing learners to fully engage in a meaningful way; otherwise, they will have wasted an opportunity to learn (Stramel, 2016). Finally, games should be modifiable so that they fit different educational need and meet the needs of diverse learners (Stramel, 2016).

1.3 The Benefits of Digital Game-Based Learning

1.3.1 Engagement

Panoutsopoulos and Sampson (2012) noted that digital game-based learning can engage and motivate people of all ages. One of the reasons for mobile digital games promoting learning and engagement is that they provide learners an escape opportunity from the real world. Digital gaming world does not have bad consequences or lasting real repercussions in the games world (Stramel, 2016). Learners can recover within game and use what they have learned to successfully complete tasks. Furthermore, mobile digital games provide activities within authentic or meaningful contexts to help learners solve problems and provide learners opportunities explore new knowledge through playing games. Digital games provide learners strategies, resources, and opportunities to transform traditional learning modes from the classroom into relevant contexts.

To highly engage learners, digital games must include rules, goals, immediate feedback, outcome evaluation, competition, and interaction. Clear rules prevent confusion and help students determine clear goals and strategies for attaining their goals. Providing immediate feedback to learners helps them to understand their areas of strength as well as their areas of weakness that are problematic and need further strengthening (Coffey, 2009; Deubel, 2006). Mobile digital games facilitate learners' engagement in their coursework and cultivate their learning as they become authentic learners actively seeking to deepen their understanding. For instance, the digital game-based learning environment found in simulation video games can enhance learners being autonomous, self-directed, goal-oriented, and successful which help learners understand the direct correlation between their effort and outcome performance. Researchers also found that mobile digital games such as educational simulations allow learners to play, make decisions, and see the consequences for their actions which are critical and associated with learners' engagement (Simpson, 2009).

1.3.2 Cognitive Skill Development

Researchers also showed the tangible benefits of using digital games to increase and enhance students' cognitive and skill development. Specifically, mobile digital games will increase learners' memory capacities such as short-term memory, long-term memory, working memory, and logical reasoning. To successfully navigate and strategically to win the games, learners are required to memorize rules, essential information, and specific sequences to complete tasks. Not only learners' cognitive skills and performance outcomes will be improved, but they also gain practical applied learning experiences.

Digital games have the added benefit of teaching students to quickly, critically, and strategically develop thinking processes (i.e., problem-solving skills). Simpson (2009) found that the digital games provide an opportunity for learning relevant

content through situated role play, problem solving, and goal attainment. Therefore, mobile digital games encourage learners to foster their desire of challenging themselves that deepen their knowledge pool. Digital games even facilitate learners' mental enhancement (Coffey, 2009).

Digital gaming takes place in a fast-paced environment that requires the learners to think and act quickly in response to situations. They also place a significant emphasis on using logic to project possible occurrences in the game, and thereby learners are required to think ahead. This is an extremely valuable tool as it is important for students to develop cognitive skills for success in school activities as well as in their future lives in the real world. As Parks (2008) states our classrooms should be the places where new media forms like digital games could be discussed, debated, analyzed, generated, refined, recycled, and played, and then they provide students with a rational and logical approach to find accurate solutions that may foster problem-solving skills in their future and require immediate attention.

1.3.3 Computer Skill Development

Digital gaming also increases learners' computer skill development which is a critical skill embodied in twenty-first century learning. Griffiths suggested that digital games can help students develop computer skills that they may need in a society (Griffiths, 2002). Mobile digital games can also benefit learners' motor development because they often involve movement, stimulate precision, coordination of movements, and speed (Simpson, 2009). Playing games allows learners effectively to use principal aspects of the computer such as the mouse, the keyboard, a controller, or joystick, as well as functional tools such as browsing and searching engines, navigating the internet, and setting up usernames and passwords. In addition, digital games can also benefit K-12 students with developing eye–hand coordination because learners must control their eyes as well as his/her and hands while playing games (Drew & Waters, 1986).

1.3.4 Supporting the Needs of Diverse Learners

Mobile digital games allow teachers to satisfy the needs of diverse learners and help all students to achieve the course goals through helpful feedback (Coffey, 2009). For instance, mobile digital interactive games help children with diverse needs such as students with attention disorders. In Griffiths' study (2002), adolescents with attention-deficit disorder showed improvements in grades, sociability, and organization after using interactive mobile digital games. Stramel (2016) also found that mobile digital games could help those learners with learning, intellectual, emotional, behavioral, and physical deficits. Digital games provide a dynamic and complex environment that can capture and retain the interest of learners.

Researchers suggested that the more time students spend engaged in learning the more they will learn. Thus, if students can become engaged participants in their learning, then academic achievement levels will be positively affected which may reduce the need for labels of disability in the future because inability to participate or successfully learn in the classroom often leads students being identified with learning disabilities (Simpson, 2009).

In addition, digital games have great diversity, so they attract and engage students of various demographic backgrounds (Griffiths, 2002). It is interesting to know that not only digital games are motivating teaching tools, but they also have been shown to serve subgroups that are typical in science education (Angelone, 2010). Research has shown that girls are just as interested and invested in engaging in digital games as boys. However, their interests do differ as they are more focused on relational and cooperative gaming (Angelone, 2010). Mobile digital games can incite learners' self-determination and provide them with a way to engage and participate in class activities which they would not have been able to engage in. This is especially important for students with disabilities because some skills such as self-determination are not usually incorporated in the general curriculum, and these students often lack these specific skills. Hence, students with disabilities can significantly benefit from digital games.

Finally, mobile digital games are highly adaptable, modifiable, and flexible to meet the needs of each learner. They have the ability to inspire and encourage learners to be active participants and customizable in their learning. Therefore, these games can be tailored for specific learners' characteristics to aid students with certain skills and abilities.

1.3.5 Collaborative Skill

Digital collaborative learning environments have shown to foster meta-reflection and higher-level cognition among learners as well as to cultivate the spirit of collaboration and support positive social relationships with others (Chen, Wang, & Lin, 2015). Digital games often benefit learners' intellectual development because they involve understanding how things work, resolving problems, and devising strategies. Although learners should be interactive with games, they also need to interact with other learners (Deubel, 2006; Coffey, 2009). Mobile digital interactive games can benefit affective and social development due to their fictional attributes. The nature of digital games includes (a) the opportunity to act out a role, (b) being a member of a group, and (c) making decisions within predominant values and attitudes in a society; digital games can enhance learners' social skill development (Gee 2003; Simpson 2009). Particularly, it is easy for learners with disabilities to feel disconnected and alienated from others, which may lower their self-esteem, self-confidence, and decrease their academic achievement and performance levels. Therefore, if a learner with a learning disability plays digital games with others who have the same interests, the students may be less likely to be stigmatized for his/her

learning differences (Simpson, 2009). This is echoed by Angelone (2010), learners with physical disabilities are often unable to play as other kids do, and the digital games create an equal access environment. In conclusion, mobile digital games could promote teamwork and communication at various subject areas and grade levels of learning. Specifically, it helps learners at various performance levels to work together in small groups or pairs toward a learning goal. Digital games provide great opportunities for learners to develop collaborative skill required in the twenty-first century.

1.4 Mobile Digital Games in K-12 Education Subject Areas

The various digital games and platforms can be integrated in all subject areas as they have demonstrated some substantial or suggestive benefits for student achievement and development. It is crucial to understand that digital games in the classroom are not a replacement for good teaching. Instead, it is a supplement of engaging learners in the content and provides an avenue for them to learn difficult concepts of the real world in an environment in which they are comfortable (Annette, 2008).

1.4.1 History

The use and involvement of digital games could support learners to gain a greater understanding of the nature and complexity of historical problems (Bysshe & Gould, 1975). Christesen and Machado (2010) examined how video games such as *Rome: Total War*, *Glory of the Roman Empire*, and *CivCity: Rome* could be used as instructional tools in the classroom providing students with enriching knowledge and excitement when learning about the ancient world. Before making decision whether to use the game to support teaching history or not, teachers should analyze the benefits of playing game how to influence students' academic achievement. For example, *Rome: Total War* is a strategy game; players attempt to become ruler of the Mediterranean world in the late Roman Republic by efficiently allocating financial and military resources (Christesen & Machado, 2010). Learners engage in historical battles during the times of ancient Greek and Roman history. This game not only helps students' engagement, but it also provides numerous pedagogical uses in learning Rome history and problem-solving skills. Further, Christesen and Machado (2010) postulate that the value of this game can help students to visualize battlefields, plan to move unites and fought, and provide several kinds of compare-and-contrast exercises. In the end of game, students could learn the historical accuracy of the game through reflecting, thinking, and writing critically.

McCall (2012) voiced the explanation for interest and engagement in historical simulation games by explaining games through offering immersive, interactive, and multimedia representations of the past in different forms of media. It will allow active participation and excitement to engage in learning provoked by players' engagement through multiple modes of communication such as visual, textual, aural, and tactile which invite the player to engage and make world-changing decisions (McCall, 2012). Students are therefore able to learn about intricate and dynamic situations and subjects through immersive environments that simplify the understanding through role playing. As McCall (2012) said, simulation games are powerful learning tools because they enable students to make meaningful choices and challenge learners to overcome deficiencies. This allows students to increase their academic achievement levels as they can deepen their conceptual understanding and investigate the implications surrounding specific historical moments.

The significance of conceptualizing these problem spaces and these systems operating with limited and enabled certain action is being a highly effective learning tool for learners in the modern world, where action continues to be contextualized by digital games (McCall, 2012). However, in a traditional history class, it is all too easy to divorce humans from their systemic contexts. Therefore, digital gaming or simulated historical experiences are essential for students to engage in as it will demonstrate to them how interwoven the concepts and systems are and provide them with an understanding of human actions and events. Simulation games play a powerful role of helping learners studying historical systems because games are systems themselves, so it is vital to keep representations of systems as analogous as possible. Unlike traditional learning environments using text to present aspects of the past than games using images, learners can virtually experience the historical systems by being able to control and manipulate aspects of the system.

1.4.2 Science

Angelone (2010) articulates that digital games with teacher facilitation can rich students' skill and knowledge in the science classroom. For example, in the mobile digital game-based science classroom, students practice taking on a new identity as scientists in laboratory and become a part of a virtual world not possible in the traditional science classroom. This allows the students to engage more deeply in the material world as they are discovering things for the first time. Digital games allow students to engage in exploration, discovery, gathering new data, and reformulating hypothesis through playing, and outcome performances could be measured and rewarded (Angelone, 2010). Such games provide students with an opportunity to become excited and motivated about learning through self-directed exploration and trial and error (Annette, 2008). Through using digital games as educational tools, a player learns to think critically about the games while at the same time gaining embedded knowledge through interacting with the environment (Annette, 2008).

There are many digital games that exist that could be used in the science classroom. One example for use in the middle school science classroom is *Zoo Tycoon*. The results have shown multiple benefits that align with pedagogy and content that can be learned through participation in digital gaming. In this game, students are to maintain and design a zoo to take care of the various animals (Angelone, 2010). Through participating in this game, students gain an understanding about how to integrate concepts, processes (such as their order and organization), scientific inquiry, life science (such as reproduction, heredity, populations, and ecosystems), and science and technology (Angelone, 2010).

1.4.3 Art

Art education has been undergoing a transformation from comprehensive approaches to a range of approaches that recognize the increasingly visual world where we are living (Parks, 2008). This re-envision of art education provides for a visual culture approach that allows learners to understand art how to affect and be affected by the broader world. Although limited studies have been conducted on the effects of digital game usage in the art education classroom, researchers believe that the processes of production, visual characteristics, content, and processes involved in digital games could make art education become more compelling. Using digital gaming in the art education classroom suggests potential benefits of creativity, imagination, and innovation as well as engagement in critical reflection. Digital games allow art education to be a catalyst for transformative learning experiences related to students lived worlds (Parks, 2008). Digital games encourage learners to experience roles and situations which are inaccessible (Frasca, 2004).

1.4.4 Literature and Language

Researchers believe that digital storytelling could capture the imagination of both students and teachers. The act of crafting meaningful stories has elevated the experience for both students and teachers (Robin & Pierson, 2005; Sadik, 2008). The digital storytelling is defined as:

> A modem expression of the ancient art of storytelling. Throughout history, storytelling has been used to share knowledge, wisdom, and values. Stories have taken many different forms. Stories have been adapted to each successive medium that has emerged, from the circle of the campfire to the silver screen, and now the computer screen. (Sadik, 2008, p. 490)

Interactive storytelling through digital gaming allows students to become active learners as they can influence and manipulate the story. Through digital storytelling and the use of these skills students can develop stronger understandings pertaining to the literature (Sadik, 2008). There is an increasing attention of using digital

games in language learning and teaching. Researchers found there are benefits to language learning by using digital games such as learning repetition and mechanics of language learning as well as vocabulary (De Juan & Laborda, 2013). Sadik's (2008) study found that integrating digital storytelling into the language curriculum is a creative language learning technique that can improve student's level of learning in reading, writing, speaking, and listening. This surge of interest and integration of digital games in this area is largely due to the notion that learning and gaming are both circular processes. Both processes require the continuous reconstruction of the learner's knowledge through interactions and collaborations with others (De Juan & Laborda, 2013).

1.4.5 Mathematics

Stramel (2016) focuses on how games can be used to promote student achievement in mathematics specifically. With rapidly evolving technology, using digital games in the classroom to promote students' achievement in mathematics is increasingly made possible. A study from Joint Position Statement (2002) found that children should experience research-based learning curriculum to be successful later as it forces them to solve real problems in the world. Digital games help them construct a foundation for success in and out of school, and earlier experiences have long-lasting outcomes on the children' future success. Abramovich (2010) illustrates children developing computational fluency required a balance and connection between conceptual understanding which provides the opportunity for meaningful practice. Digital game-based for learning mathematics must be made adaptable and modifiable to the ages, interests, languages, and cultures of the learners' diverse needs. It will allow learners to explore counting sequences, computation strategies, etc., and form deeper understandings, reasoning abilities, and encourage strategic thinking. Stramel exemplified several different digital games that could be used in the mathematical subject area such as *Connect Four*. This game could be adapted easily while teaching multiplication, addition, and subtraction. For instance, players could add up the sum of two die that they roll, strategically choose which number they will cover, and once they have four in a row that player wins. This game also tests their addition strategic problem solving. Games can be used to promote learning and lay the foundations for future learning of mathematics. Even the basic level of problem solving in this game could be expanded beyond school years.

1.5 Conclusions

Mobile digital games have become popular because they are fun. Since the 1980s, it has increased to 60% of children and 97% of young people playing digital games. This demonstrates their pervasive nature and thus the importance of educators

considering their integration as an educational tool to benefit student learning in the classroom. Specially, teenagers often lack interest in curricular contents. The disengagement from course material has a significant impact on students' learning. For a mobile digital game to be successfully utilized in the classroom, educators should decipher the match between a game and the objective of the lesson (Shah & Foster, 2014). It is imperative for teachers to find how to use mobile digital games to transform disengaged learners into authentic and engaged students. Therefore, it can be implied that digital games have advantages from a pedagogical perspective.

Research has shown that digital games contain rich potentials for academic gains for students in the classroom. Students who play digital games are typically engaged, persistent, and succeed (Simpson, 2009). Such benefits cannot be overlooked, and mobile digital games can be utilized as an educational tool to bolster learners' cognitive and many skills development. Digital games motivate learning through providing curiosity, fantasy, fun, and social recognition (Annette, 2008). Coffey argues that if teachers want to effectively use game-based learning in the classroom, they must first find nonviolent games that facilitate planning and problem solving and relate to the curriculum. Specifically, some mobile digital games such as simulation and adventure games are highly advocated for use in the classroom because they often appeal to the development of more than just skills (Coffey, 2009).

According to previous theoretical frameworks, it suggests that learning is more effective when learning is active and problem-based which is accompanied with immediate feedback in a meaningful learning context which a traditional learning environment may not able to support learning digital natives. It is necessary to implement mobile digital games to become relevant and relatable to students' learning. Digital games used for educational purposes could foster students being the part of learning environment rather than being a passive recipient listening to a teacher. Learners are no longer observers, but are protagonists who make decisions that affect the game world (Saez-Lopez, Miller, Vazquez-Cano, & Dominguez-Garrido, 2015). De Juan and Laborda (2013) noted that digital games can promote self-directed learning which is facilitated by the adequate support, scaffolding, reflection, and critical thinking. Therefore, by engaging in digital games, students develop twenty-first century skills such as self-governance, critical analysis, self-evaluation, and strategic problem solving which are vital skills for their future success.

In conclusion, mobile digital game-based learning in educational settings has become a common practice. This common usage of digital games in the classroom is because educators realize the immense beneficial effects that games can have on student achievement. Therefore, it is vital to continually develop the positive potential of digital games and be aware of possible unintended negative effects (Griffiths, 2002). Also, it is essential for teachers to consider the cognitive and physiological effects that the game may have on their student learners (Deubel,

2006). Digital natives play games on their own to understand their world from outside of formal education structures. When games are properly used and deployed in education, students' performances will improve (Chen et al., 2015).

1.6 Limitations and Future Direction

Some people believe that digital games in the classroom can prove to be detrimental to the learning and development of students. Such advocates believe that digital games as an educational tool ultimately are too distracting for the learner and thus obscure the academic goals of the game. Another criticism of the inclusion of digital games is that it is difficult to find a game that closely identifies with the pedagogy (De Juan, & Laborda, 2013) or the use of digital games as educational tools exist (McCall, 2012). Additional limitations and challenges do exist in other studies of digital game-based learning. Therefore, it is imperative to be cognizant of them to best implement them as an instructional tool in the classroom. To address this concern, educators or researchers must determine whether the content of the game is appropriate for specific age groups and whether the games are suitable for the standard-based accountability movement (Coffey, 2009). However, despite these limitations and challenges, they provide guidance for developing serious educational games that motivate and engage young learners toward digital game playing in positive ways (Owston, 2009).

Glossary

Twenty-first century skills a series of higher-order thinking skills which have been identified in many disciplines including schools and workplace to succeed in twenty-first century.

Constructivist theory of education it connects educational content with computer or mobile digital games which can be used in almost all subjects and skill levels.

Controller interface mouse, joysticks, or keyboards.

Cooperative gaming a game provides interaction with other learners to solve problems together.

Error–feedback reconstruction learners' knowledge is built through continuous error and correct feedback during the learning process.

Intrinsic motivation self-desire to seek out and gain new knowledge.

Mental quickness the cognitive speed of processing information.

Meta-reflection higher-level cognition or problem-solving skills.

Multi-sensory vision, audition, touch, smell, taste, etc., all work together.

Mobile digital games digital games such as video games implemented in a mobile interface.

Strategic reflective questions or scaffolding reflection The questions could facilitate learners to reflect their learning. For example, "what is the most important aspect about mathematics you learned from this game? What strategy did they use to help you to play this game? What was tricky about this game? Can you connect the math that you learned in this game to something you learned in class? How is this knowledge useful outside the classroom? What was the most fun thing about the game? How did you feel when you played the game? What were your strengths when playing the game? What advice would you give to someone to play the game in the future?"

Virtual world a computer-based simulated environment allows learners to learn and solve problem as in a real-world setting.

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Chapter 2
Mindfulness in Mobile and Ubiquitous Learning: Harnessing the Power of Attention

Agnieszka Palalas

Abstract Mobile and other digital technologies facilitate ubiquitous learning that offers unprecedented benefits. With mobile learners being able to "squeeze in" learning in-between other daily activities, they face contesting demands on their attention and their brain. Their learning experience might be hindered by multi-tasking, distraction, mind wandering, and even problematic dependence on digital devices. These influences are addressed in the chapter, and recommendations are presented on how to promote higher levels of attention and engagement in m-learning events. Based on the latest empirical evidence, mindfulness strategies can aid in attention regulation and cultivation of "healthier" learning habits, thus alleviating these problems amongst mobile learners. Recent discoveries in neuroscience and the renewed understanding of brain plasticity are bridging the science and practice of mindfulness. Combined with 35 years of scientific research in mindfulness, more recent exploration of the applications of mindfulness in education has demonstrated that learners can train their mind to respond to stimuli in a purposeful controlled manner leading to more successful learning. Incremental mindfulness practice tunes up our nervous system and strengthens the neuro-components that help us connect with our intentional attention capabilities. It is hence the purpose of this exploration and the resulting chapter to identify such learner-centered strategies to promote the development of mindfulness practice leading to enhanced intentional attention in mobile learning. Mobile technologies can be used to provide scaffolds for learners to engage and persist in mindful learning and practice of mindfulness. The author presents a variety of proven mindfulness practices and techniques that can be adapted in the m-learning design. She concludes with a call for more interdisciplinary studies and rigorous explorations of the intersection of mobile learning, education, instructional design, contemplative practices, cognitive science, and neuroscience to attain a better understanding of how to harness attention in mobile and ubiquitous learning.

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