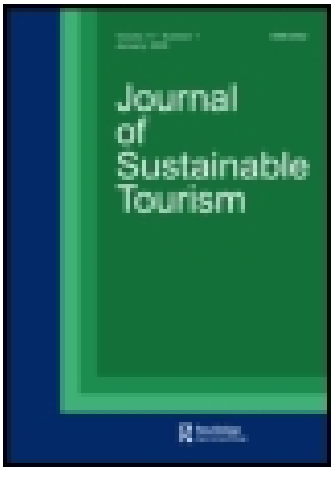

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mLearning as a softer visitor management approach for sustainable tourism

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mLearning as a softer visitor management approach for sustainable tourism

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With increased visitation to protected natural areas over the last four decades, there is a need for implementation of effective visitor management strategies at these sites to mitigate visitor impacts. This study explores the application of mobile learning (mLearning) in environmental interpretation and visitor education within the context of conservation and sustainable tourism. Specifically, it proposes a conceptual framework for mLearning as a visitor management tool for sustainable tourism. Current developments and innovations in mobile broadband networks, smartphone technology, and mobile software applications present opportunities for the utilization of such mobile-driven applications in interpretive programs to encourage free-choice learning and mindful visitor experiences. If effectively implemented, such interpretive programs and mLearning applications can affect visitor perceptions, attitudes, and future intentions toward conservation and environmental protection.

Keywords: mobile learning; environmental education; interpretation; conservation; visitor management; sustainable tourism

Introduction

Given the developments in infrastructure, technology, and economy in the last four decades, people are now increasingly traveling to and interacting with protected natural areas (Newsome, Moore, & Dowling, 2007). Thus, the planning and development of effective site and visitor management strategies for such destinations are a crucial undertaking. Arguably, there is an opportunity to include alternative interpretive and visitor learning options (e.g. mobile-driven techniques) in these natural areas, particularly those most heavily visited to provide learning opportunities and manage impacts. Alongside global efforts to protect natural areas, the rhetoric on sustainable tourism and environmental conservation continues to be actively debated (Butler, 1999; Hopwood, Mellor, & O'Brien, 2005; Weaver, 2008). However, the discourse on the use of education and interpretation to influence visitor management and sustainability outcomes has been less developed, particularly within the context of learning derived from tourism experiences (Falk, Ballantyne, Packer, & Benckendorff, 2012). In particular, the application of mobile and communication technologies in such contexts is still at its infancy.

Despite the ubiquity of smartphones and other mobile devices (Gartner, 2013; International Telecommunication Union [ITU], 2013) and increasing attention paid to innovations and applications within the tourism context (Buhalis & Law, 2008; Dickinson et al., 2012; Yang & Hwang, 2013), significant research that focuses on the use of such mobile-

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driven technology in environmental interpretation and sustainable tourism education is yet to be conducted. While there has been research exploring the benefits and application of information and communications technologies and mobile-driven applications for interpretation and sustainable tourism (Ali & Frew, 2013; Hilty & Ruddy, 2010; Liburd, 2005; Makrakis, Larios, & Kaliantzi, 2012; Zelenika & Pearce, 2012), virtually no research has been done on the application of the principles and communication outcomes of mobile learning (also referred to as m-learning or mLearning; the latter is used hereafter) in interpretive programs, environmental learning, and conservation within the sustainable tourism context. With the unprecedented growth in global smartphone sales and mobile broadband subscriptions, service providers have responded by putting forward a wide range of network services and mobile-driven applications (Gartner, 2013; ITU, 2013). With extensive market penetration and the prevalent utilization of mobile devices, research related to users and their usage practices has also increased, particularly in domains such as implications for social change, routes of interaction, and the pedagogical and psychological dimensions of mobile communication (Contarello, Fortunati, & Sarrica, 2008; Liburd, 2005). Consequently, personal use of mobile devices and technologies for learning and education has increased, particularly in collaborative, self-regulated, and outdoor learning situations (Sha, Looi, Chen, & Zhang, 2011; Uzunboylu, Cavus, & Ercag, 2009).

Literature reviewed in the present study shows that current research on mLearning is focused on formal learning and education. Significant research has yet to be conducted on the mLearning process and outcomes of tourism experiences, particularly within the context of free-choice/informal learning and mindful visitor experiences for conservation and sustainable tourism. Despite existing studies on mobile technology and its applications in tourism, most of these focus on information search preferences, usability, recommender systems, or social networking (Luz, Anacleto, & Almeida, 2010; Wang, Park, & Fesenmaier, 2012; Wang & Xiang, 2012; Yang & Hwang, 2013). Thus, there is opportunity to review the contribution of mobile-driven applications and mLearning in sustainable tourism and visitor management. This paper reviews the application of mLearning in environmental interpretation and visitor education for sustainable tourism. Specifically, it explores the use of such applications in visitor management strategies and free-choice learning situations to encourage visitor mindfulness, conservation ethics, and environmentally sustainable behavior. This work also proposes a conceptual framework that outlines the core research dimensions of (1) mobile-driven interpretation and education, and (2) mLearning and mobile applications. It aims to answer the following research question: *How can mLearning be used as a visitor management tool in sustainable tourism?* This study investigates the (1) mLearning outcomes that can be achieved through soft visitor management strategies and environmental interpretation, (2) major issues in mLearning that can impact visitors' learning and interpretive experiences, and (3) use of mLearning applications to encourage mindful, free-choice learning for environmental conservation.

Literature review

Visitor management, interpretation, and education for conservation

Despite the support and advocacy for sustainability, its actual implementation is complex (Butler, 1999) and there is no one-size-fits-all strategy for sustainable tourism and visitor management (Lane, 2009). There have been divergent approaches to sustainable tourism practices and visitor management strategies developed over the years in an effort to manage visitor impacts (Butler, 1999; Stewart, Glen, Daly, & O'Sullivan, 2001). Commonly,

these visitor management strategies have advocated control mechanisms, visitor education, and interpretation as the foundation for influencing human behavior and sustainable development (Mason, 2005; Poudel & Nyaupane, 2013). Orams (1995) described three management strategies to cope with tourist behavior and impacts on protected natural areas: (1) physical control (e.g. designated infrastructure or access control), (2) direct control (e.g. legislation and usage fees), and (3) indirect control (e.g. education and interpretation). Conversely, Newsome et al. (2007) clustered management strategies into (1) site management, where the objective is to manipulate or control visitor access and usage of the site; and (2) visitor management, which focuses on managing visitors by regulating numbers or group size, communication, and education. A holistic approach to managing hard and soft management strategies is recommended. However, this study specifically focuses on soft visitor management strategies and interpretation aimed at fostering conservation learning and environmental consciousness.

Weaver (2008) suggested that expected sustainable tourism outcomes might not be accomplished if visitors are given direct educational instructions that are too academic, abstruse, or harsh. He instead recommended an indirect or soft persuasive approach to convince and influence rather than direct rules and enforced behavior. Kuo (2002) similarly recommended shifting attention to visitor management strategies that focused on positive development and persuasive interpretation, rather than merely applying regulatory restrictions and penalties, which could trigger visitor dissatisfaction and misinterpretation of such actions. Conservation messages and interpretation should consider the uniqueness and conditions of each site, its associated environments, and visitor type. The need to customize interpretation and visitor experiences has been articulated in numerous studies (Beaumont, 2001; Hughes, Bond, & Ballantyne, 2013; Reisinger & Steiner, 2006; Xu, Cui, Ballantyne, & Packer, 2013), in which visitors' motivations, expectations, previsit knowledge, socio-demographic and cultural backgrounds are considered. The application of soft visitor management strategies within ecologically or culturally sensitive tourism areas can be the means through which appropriate visitor behavior is encouraged, knowledge is acquired, and positive attitudes or behavioral intentions are motivated (Mason, 2005; Orams, 1995; Poudel & Nyaupane, 2013).

Interpretation is the process through which information is communicated to visitors about a destination to encourage concern and appreciation of the place through knowledge acquisition and education (Moscardo, 1998; Stewart et al., 2001). Ham (1992) explained that interpretation translates technically or scientifically complex information into language and ideas that non-experts can readily understand. He highlighted four qualities that distinguish interpretation from other forms of information transfer: the interpretive approach to communication is (1) pleasurable, (2) interesting, (3) relevant, (4) organized, and (5) thematic. Additionally, Newsome et al. (2007) proposed an education−knowledge−awareness trilogy in the interpretive process, wherein effective interpretation is achieved through a synergy of (1) educational activities (e.g. facilitating knowledge and understanding of environmental issues), (2) recreational activities (e.g. emotionally stimulating and enjoyable visitor experiences), and (3) conservation-supporting behavior (e.g. inspiring sustainable behavior and environmental protection).

Ultimately, most interpretive programs aim to influence visitors' pro-conservation attitudes and sustainable behavior through an educational process (Mason, 2005; Reisinger & Steiner, 2006). Interpretive programs may include but are not limited to wayfinding and trail-side interpretive signage, interactive exhibits, audio-visual materials, brochures, guided tours, visitor centers, community outreach programs, and other online and offline information (Ballantyne, Packer, & Hughes, 2008; Hughes & Morrison-Saunders, 2002; Law &

Ting, 2011; Weaver, 2008; Wong, 2013). Despite the numerous contextual approaches to interpretation, the consensus is that interpretation should not only be about the presentation of factual information but also be an interesting, entertaining, and educational activity directed toward communicating meaningful relationships, discovering new knowledge, and inspiring affirmative action. Unlike direct visitor management strategies, education and persuasive communication do not impose overt enforcements or controls. Visitors are instead encouraged to engage voluntarily in sustainable behavior through positive messages, self-discovery, and experiential learning (Newsome et al., 2007; Reisinger & Steiner, 2006). The freedom to choose promotes positive learning outcomes and sustainable future behavior.

The notion of free-choice learning was discussed by several authors (Falk et al., 2012; Falk & Dierking, 2000; Yamada & Knapp, 2010), who suggested that self-directed informal learning (as opposed to learning in a formal education setting) should be personally motivated by involving considerable choice on the part of the visitor in terms of how, what, when, and where they learn. Given that this form of learning typically occurs in tourism, its implications should be considered when designing interpretive programs. However, Falk et al. (2012) noted a lack of attention in exploring the nexus between learning and travel. The authors called for a holistic approach to evaluating learning in tourism, since tourism experiences offer opportunities for people to acquire knowledge, generate new ideas, and develop new self-identities or perspectives. Zeppel (2008) had suggested an experience−learning−action model to heighten visitor knowledge and empathy during free-choice visitor experiences; and facilitate effective on-site environmental learning and future conservation intentions. Affective (emotional) and cognitive (intellectual) responses generated through interpretive experiences mediate the tourism encounter to influence pro-environmental attitudes and socially responsible behavior (Zeppel, 2008; Zeppel & Muloin, 2008).

Similarly, Weiler and Smith (2009) had investigated interpretive outcomes and visitor behavior in terms of observed cognitive, affective, and behavioral indicators vis-à-vis the level and type of interaction with different interpretive media. However, transforming long-entrenched attitudes and behavior can be difficult; particularly if interpretive programs emphasized on cognitive rather than affective learning processes (Beaumont, 2001). Thus, interpretive programs should balance the cognitive, affective, and behavioral stimulations vis-à-vis the attitudes and behaviors of different visitor types to ensure sustained pro-conservation ethics and environmental consciousness. In sum, interpretation and visitor education play a key role in managing visitors and the quality of their experience by: (1) sharing information, (2) managing visitor safety and comfort, (3) creating experiences, (4) aiding visitor engagement, (5) conveying symbolic meanings, (6) influencing appropriate behavior, and (7) inspiring pro-conservation intentions (Ballantyne, Packer, & Hughes, 2009; Madin & Fenton, 2004; Moscardo, 1998; Zeppel & Muloin, 2008).

mLearning: principles, practices, and issues

With the increased demand for mobile services, growth in mobile broadband subscriptions, and price decrease of smartphones in recent years (ITU, 2013), new mobile applications and technologies are being developed and mobile-driven social communications are evolving. These changes have led to developments within the education sector (Hashemi, Azizinezhad, Najafi, & Nesari, 2011; Jeng, Wu, Huang, Tan, & Yang, 2010; Martin et al., 2011; Ozdamli & Cavus, 2011). However, as mLearning is an evolving domain still in its infancy, no consensus has been reached with regard to a standardized definition and the

discipline that it should belong to (Crescente & Lee, 2011). Additionally, debates continue on the effective pedagogical and content adaptation of transforming learning content and courseware from traditional or other digital/electronic platforms to conditions suited to mobile device usage (Su, Tseng, Lin, & Chen, 2011). The consideration of constraints imposed by human, design, and institutional dimensions is necessary when implementing mLearning systems and technology to ensure meaningful learning applications (Sha et al., 2011).

Wu et al. (2012) defined mLearning as learning wherein "learners engage in educational activities, using technology as a mediating tool for learning via mobile devices assessing data and communicating with others through wireless technology" (p. 818). Conversely, Crescente and Lee (2011) applied the concept of mLearning as an evolution and adaptation of e-learning in handheld devices that provide assimilated learning opportunities for learners at anytime from anywhere. In adapting previous studies on mLearning across concepts of engagement with technology, locality (mobility), communicative interactions, and learning conditions, Wali, Winters, and Oliver (2008) reconceptualized mLearning using the activity theory concept and defined it as "learning that occurs as a result of pursuing learning activities … directed towards achieving some objective in multiple contexts (physical and social)" (p. 45). Liaw, Hatala, and Huang (2010) likewise proposed a framework for mLearning, wherein active learning is determined by the juxtaposition of the learners' (1) control of learning, (2) context of learning, and (3) communication of learning.

This notion of contextual learning was discussed by Westera (2011), who advised that learning should not take place in a vacuum and that new learning technology should mediate and facilitate rather than restrict. Within the context of mLearning, mobile-driven innovations can offer the key elements of ubiquitous mobility and situated contextual learning to enrich the learning experiences and activities of users (Jeng et al., 2010) and to advance collective knowledge building within formal and informal settings (So, Seow, & Looi, 2009). Formal mLearning refers to learning that occurs within a structured or specifically built facility led by an instructor, whereas informal mLearning focuses on self-regulated or ad hoc learning conditions (Sha, Looi, Chen, Seow, & Wong, 2012). Unlike traditional learning situations, informal learning experience occurs across temporal, spatial, and conceptual boundaries (Hashemi et al., 2011).

To achieve specific learning outcomes, mLearning activities and content should be planned and designed for (1) different devices/mobile platforms, (2) multiple learning tasks and knowledge goals, (3) different learning spaces and contexts, (4) learner mobility and familiarity, and (5) improved accessibility, usability, and learnability (Wang & Shen, 2012; Westera, 2011; Wong, 2012). This approach should be adopted to ensure optimal application of mLearning across a broad gamut of learning conditions and activities (Caverly, 2012; Hashemi et al., 2011; Su et al., 2011). Within the context of mLearning in natural science education, Liu, Peng, Wu, and Lin (2009) used the 5E learning cycle (consisting of the following stages: engagement, exploration, explanation, elaboration, and evaluation) as the pedagogical foundation upon which natural science learning activities for mLearning were developed. Their findings confirmed that the hands-on inquiry-based approach (combining 5E and mobile technologies in outdoor learning environments) enhances knowledge, learning and motivational outcomes.

From the literature reviewed, a number of key characteristics are commonly articulated as being necessary for effective mLearning. These characteristics are summarized in Table 1 (Crescente & Lee, 2011; Hashemi et al., 2011; Jeng et al., 2010; Liu, Li, & Carlsson, 2010; Liu, Tan, & Chu, 2009; Lopez, Royo, Laborda, & Calvo, 2009;

Table 1. Summary of 12 common characteristics of mLearning.

Ubiquity/seamless	Wireless technology that facilitates ubiquitous learning anytime and anywhere across multiple learning environments
Portability	Mobile devices that are smaller and more portable than traditional computing devices; can be used in locations not traditionally accessible by fixed networks
Context-specific	Learner-centric and context-aware; can be learned in the real-world context
Interactive	Interactive learning through active engagement
Collaborative	Socially interconnected and allows collaboration between learner, instructor, and other learners
Immediacy/real-time	Instant, real-time information and feedback; easy access to learning content
Personalized/private	Individual and independent access to information; learning habits and preferences
Integrated/blended	Can successfully be combined with other teaching and learning tools
Connectivity	Constant uploading/downloading of content and links to online/virtual learning environments
Simplicity/flexible	Information and content in "bite-sized" (small) packages, thus allowing for simplicity, flexibility/adaptability, and easy access
Permanency	Learning behaviors, processes, or portfolio can be recorded and stored
Immersive	Learners can experience similar affective states (of feelings and emotions) when interacting with virtual content (as they would in reality)

Ozdamli & Cavus, 2011; Rogers, Connelly, Hazelwood, & Tedesco, 2010; Terras & Ramsay, 2012; Westera, 2011; Wong, 2012). It is vital that mLearning applications customize content and information according to the needs of the learner and the context within which learning occurs. As reiterated by Martin et al. (2011), such applications should be synergistically integrated with existing learning tools and platforms that "interact with each other in a digital ecosystem of mobile applications and services through accepted standards, fostering inter-operability and easy extension" (p. 1883). Liu et al. (2010) and Smith and Walters (2012) also highlighted the need to recognize the factors that drive mLearning adoption. Consequently, Liu et al. (2010) applied the technology acceptance model to determine the perceptions and attitudes of end users toward technological innovations and adoption. They found that perceived usefulness and ease of use are significant predictors of user intention.

mLearning has progressed through an evolution of user acceptance and adoption stages similar to any new technological innovation or service/product idea. mLearning is expected to become an accepted feature of an integrative learning environment with the ubiquity of wireless communication and mobile devices, wherein users (evolving from being *m-immigrants* to *m-natives*) become accustomed to its use and embrace the freedom of choosing what, how, where, and when they want to learn (Crescente & Lee, 2011). When developing this mobile world of learning, it is important to not only focus on the "mechanics of how to disseminate and affect technological access" but also on creating an integrative learning environment that encourages independent self-directed learning, personal responsibility, and critical thinking (Ward & Prosser, 2011, p. 175).

Mobile applications in tourism, visitor management, and interpretation

Currently, mobile technologies and software applications offer virtually unlimited options catering to the communication, information, and social connectivity needs of users while

traveling. Advanced mobile services and network capabilities allow for interactive social communication and rich multimedia content, both of which are transforming tourism consumption (Charitonos, Blake, Scanlon, & Jones, 2012; Liburd, 2005; Wang & Xiang, 2012). However, despite the ubiquitous adoption of mobile-driven technology and its applications, research into the role of such technology in visitor management, interpretation, and its implications for mediating the tourism experience is still limited (Dickinson et al., 2012; Peres, Correia, & Moital, 2011). Mobile-driven technology applications in tourism and interpretation include but are not limited to (1) mobile searches; (2) mapping, location-based, or navigational services; (3) user self-reservations and check-ins; (4) interactive and social communications; (5) barcode scanning; (6) language assistance; (7) currency conversion; (8) entertainment or edutainment multimedia; and (9) destination guides and recommender systems (Langelund, 2007; Luz et al., 2010; Milic-Frayling, Hicks, Jones, & Costello, 2007; Wang et al., 2012; Wang & Xiang, 2012).

With the vast technological and software options available to both end users and service providers, accurately determining the mobile services that are considered value-added and relevant can be difficult. Mobile service features should not be planned or developed in isolation but as parts of an integrated multi-channel service package (Koivumaki, 2002; Milic-Frayling et al., 2007). Despite the broad application of mobile-driven innovations in tourism, from the literature reviewed it was observed that the exploration of mobile-driven applications within the context of visitor mLearning and environmental interpretation has yet to be adequately examined. Investigating the attitudes and usage preference of users toward mobile-driven technology and applications is needed to ensure usability, a positive perceived value, and achievement of desired interpretive and mLearning outcomes. To address some of the potential pitfalls and challenges of outdoor and mobile teaching, Liu et al. (2009) proposed an environment of ubiquitous learning with educational resources (EULER) learning model (some features of which are similar to the characteristics outlined in Table 1) for outdoor learning, which is supported by radio-frequency identification (RFID), augmented reality, wireless technology, ubiquitous computing, embedded systems, and database technologies to create a mobile, immersive learning environment.

The significance of developing mobile applications that specifically cater to the usage needs of tourists was explored by Tan, Foo, Goh, and Theng (2009), who emphasized the need to have a detailed contextual understanding of tourists' usage patterns, informational retrieval goals, and commonly executed tasks on such mobile platforms. The authors proposed a contextual information model representing five types of contextual information needs that should be considered when designing suitable context-aware applications within the tourism arena: (1) temporal: based on time, date, or seasons; (2) identity: based on users' background, preferences, or activity; (3) location: based on location or proximity; (4) environmental: based on weather, traffic, or ambient conditions; and (5) social: based on social networking, user-generated content, or group interests (TILES). Additionally, Dickinson et al. (2012) highlighted the need to consider the temporal, spatial, and place-related capabilities of smartphone applications because these applications allow visitors to obtain real-time information and to "visualize the spatial relativity of tourist facilities, resources and activities, (leading) to knowledge-rich visitors" (p. 15), thereby creating opportunities to customize travel planning and to personalize visitor experiences.

In reviewing the contributions of mobile technology in tourism, Wang et al. (2012) discussed smartphone capabilities in mediating tourism experiences, shaping attitudes, and creating destination impressions. The authors reviewed these mediation potentials alongside the three phases of a typical touristic experience (i.e. anticipatory, experiential, and reflective). Watson, Akselsen, Monod, and Pitt (2004) discussed three similar phases

of tourism experience during which tourists may benefit from technology use: (1) planning: pre-trip activities such as information search, (2) touring: on-site activities and tourist experience, and (3) reminiscing: post-trip reflection or word-of-mouth. Amalgamating the above, Liburd's (2005) study had discussed the potential for mobile tourism services to contribute content and utility value before, during, and after the tourism experience by communicating social and place-identity shaping activities.

The above discussions indicate that current research on mobile technology and software applications has focused more on the overall tourist experience or usage preferences while traveling rather than specifically on the mLearning outcomes of environmental interpretation and conservation education. Hence, opportunities to investigate the use of mobile applications within this context are available, particularly if considered in conjunction with the mLearning principles discussed. For example, although the tourist (electronic) experience model proposed by Watson et al. (2004) was not specifically designed for environmental interpretation and mLearning, its basic principles can be suitably adapted within the context of sustainable tourism for an integrative and synergistic visitor management approach. Simultaneously, the real-time integration of these mobile and communication technologies could further enhance overall tourist satisfaction and widen visitor management outcomes in nature-based attractions or protected areas by (1) allowing information access anytime and anywhere, (2) maximizing time spent at the destination, (3) allowing various activities to be undertaken, (4) providing quality and variety in information, (5) offering a wide array of choices, (6) facilitating evaluation and monitoring, and (7) contributing feedback for future strategic planning and development (Liburd, 2005; Peres et al., 2011).

Methodology and conceptual framework

The objective of this study is to evaluate the application of mLearning in interpretive programs for sustainable tourism. This study reviewed relevant literature consolidated into two main research streams: (1) visitor management strategies, interpretation, and education, and (2) mobile learning (mLearning) and smartphone applications. The research was undertaken in three stages. First, a broad search for literature within the two research streams was undertaken during the initial stage. Abstracts and/or outlines of returned results were examined for their relevance to the research theme. This initial phase helped guide the development of the preliminary research objectives and questions as well as formulation of appropriate Boolean phrases and keywords for further search. In the second stage, Boolean phrases and keywords were generated based on definitions and narratives gathered from the preliminary literature search within each research stream. Keywords were combined with Boolean operators to narrow or broaden the search to facilitate the return of sufficient and congruent results. Particular attention was given to literature on mobile learning and environmental interpretation. The Boolean phrases and keywords eventually used in the final literature search were as follows: [mobile learning *OR* m-learning *OR* mLearning] *AND* [environmental education *OR* education *OR* interpretation *OR* conservation *OR* sustainable tourism *OR* tourism *OR* sustainability]. The database search was carried out between September and November 2013 from three of the largest and most popular databases (Buhalis & Law, 2008; Law, Qi, & Buhalis, 2010; Law, Ye, Chen, & Leung, 2009): (1) EBSCOHost (http://search.ebscohost.com), (2) Science Direct (http://sciencedirect.com), and (3) Google Scholar (http://scholar.google.com).

The snowball technique was also utilized to search for related articles cited in the original retrieved articles to ensure a comprehensive coverage of the subject area. A total

of 215 articles and reference resources were generated in the initial search. Content analysis and synopsis was conducted for the retrieved literature, followed by their categorization into each research stream. Each resource was further tabulated according to (1) title, author(s), and publication year; (2) mLearning category; and (3) research context and focus area(s). In the final stage, approximately 130 references from the initial 215 retrieved resources were determined to be most suitable and congruent to the research objectives. These literature references were re-read, reviewed, and coded according the thematic areas. Moreover, potential research gaps and future research directions were identified.

The concept map (Figure 1) and proposed conceptual framework (Figure 2) show that each research stream focuses on particular dimensions. This study specifically observes aspects of soft visitor management strategies concerned with environmental interpretation, conservation learning, and communication of education. For the dimension of visitor management and interpretation, this study focuses on learning and interpretive outcomes to assess its effectiveness. Thus, the framework adapts the indicators of effective interpretive outcomes by Weiler and Smith (2009) and Zeppel and Muloin (2008), through which cognitive, affective, and behavioral responses from interpretive and visitor learning experiences are measured. Within the dimension of mLearning and mobile applications, this study is primarily concerned with cognitive and pedagogical (i.e. learning process and educational activities) outcomes rather than the technological or architectural features of mLearning. Thus, it adapts the 5E learning cycle of guided inquiry for natural sciences by Liu et al. (2009) and the TILES model of contextual information needs by Tan et al. (2009), which should be considered when designing suitable context-aware applications and mLearning content. This study proposes a conceptual framework that enables the investigation of the effectiveness of mobile-driven interpretation and mLearning as a

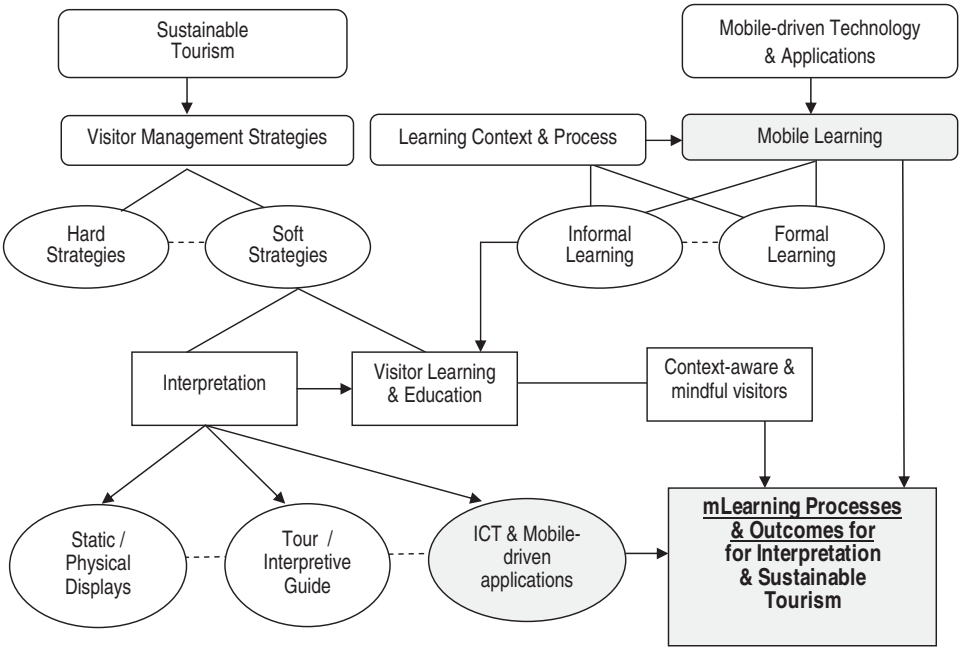

Figure 1. Concept map of mLearning for interpretation and sustainable tourism.

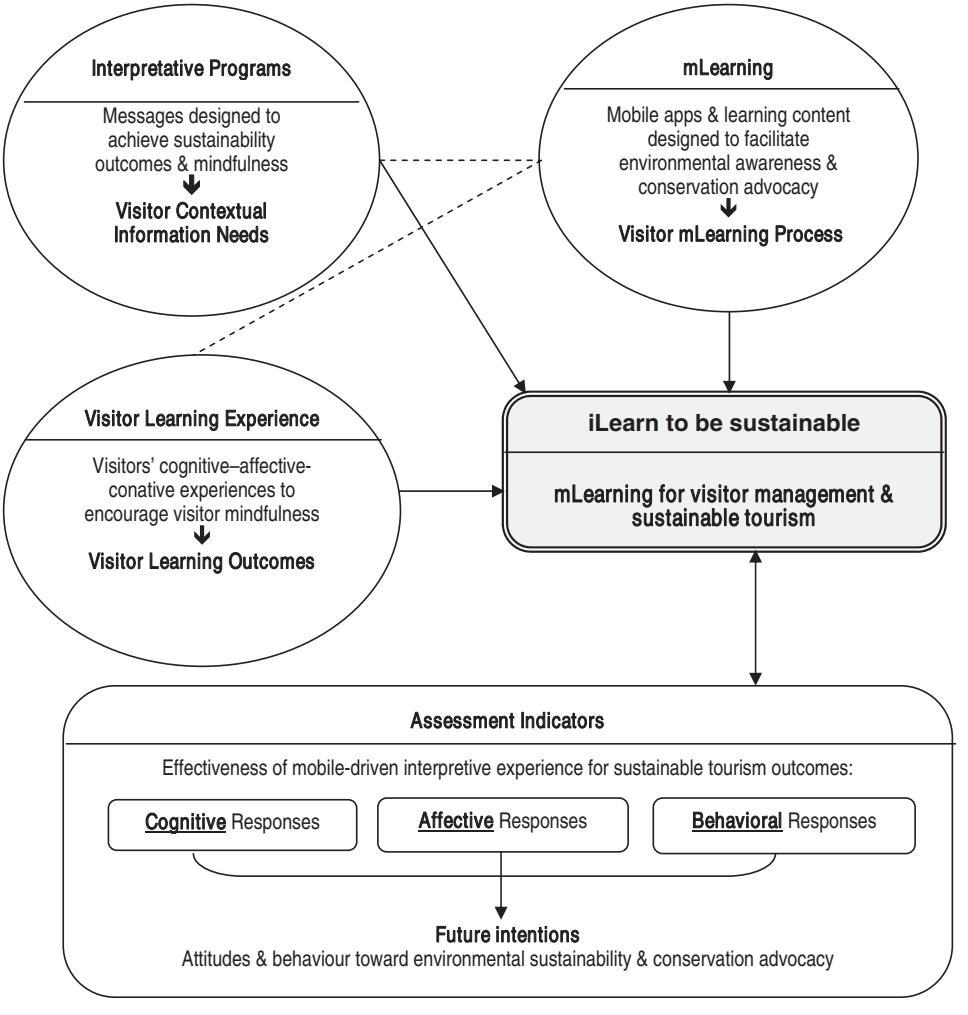

Figure 2. Conceptual framework of mLearning as a visitor management strategy.

mediating channel to facilitate visitors' interpretive and learning experiences toward sustainable tourism outcomes. To do so, indicators assessing visitors' cognitive, affective, and behavioral responses are suggested (Figure 2).

Discussion

mLearning applications in tourism and environmental education

The current discourse on mLearning is predominantly centered on evaluating: (1) advantages and disadvantages of mLearning, (2) learner attitudes and perceptions (or receptiveness) to mLearning, and (3) effectiveness and development of appropriate mLearning systems or software to facilitate learning (Lopez et al., 2009; Ozdamli & Cavus, 2011; Wu et al., 2012). However, assessing the functionality of the content and user navigability is important when designing content and/or mobile applications for mLearning within the context of interpretive programs because these two factors will have implications on the

degree of knowledge acquisition and mLearning process outcomes (Lopez et al., 2009). Similarly, developers should consider the learning context within which educational activities occur (Wang & Shen, 2012; Westera, 2011). Hashemi et al. (2011) and Jeng et al. (2010) emphasized that context-aware ubiquitous learning opportunities generated by mLearning enable learning experiences and activities across temporal, spatial, and conceptual spaces. Thus, educational content must be adapted to personalize learning conditions and outcomes suited to the diverse needs of learners (Su et al., 2011). Considered in conjunction with the education−knowledge−awareness (Newsome et al., 2007) and experience−learning−action (Zeppel, 2008) trilogies for effective interpretation and visitor management, the necessity of synergizing the socio-psychological aspects of human−technology interaction becomes crucial, particularly within the informal/free-choice learning context seen in most tourism experiences.

This section of the paper reviews the current discourse on mLearning within the purview of tourism and environmental education. This review includes an analysis of mLearning applications across different domains of education clusters and subject areas in general. Table 2 illustrates that the current research interest in and application of mLearning are dispersed across a number of subject areas. A prominence of applications within the formal education and higher education sectors was observed, particularly within the context of environmental education and natural science. By contrast, mLearning within the tourism and hospitality sectors is given little attention. Research and development in both sectors is mainly focused on practical rather than educational applications.

Table 2 categorizes current research and applications based on listings within (1) mLearning categories in tourism and environmental education and (2) general educational categories. The rationale for concentrating the analysis on tourism and environmental mLearning is in line with the research objective of focusing on mLearning applications and issues within the context of environmental interpretation and sustainable tourism. As highlighted, the goal of this study is to suggest appropriate evaluation criteria and measurement indicators for assessing the effectiveness of mLearning within interpretive programs for sustainable tourism. For the purpose of categorization and analysis, the study focuses on mLearning and its related applications. Hence, studies pertaining to only e-learning, blended learning, or teaching pedagogy applied in traditional (offline) learning contexts are excluded. Table 2 describes each mLearning category, the research context or subject area focus, and an article count/percentage distribution of the studies within each category. It shows that the current research and applications of mLearning in tourism and the environment are strongly focused on formal education conditions within the environmental and/or social science disciplines. A limited amount of research is focused specifically on mLearning within the tourism and hospitality contexts (Bellotti et al., 2003; Charitonos et al., 2012; So et al., 2009) and virtually none specifically within the context of interpretive programs for environmental conservation and sustainable tourism. A significant opportunity for further research is present within this domain.

mLearning as a softer visitor management approach

Falk et al. (2012) advocated the need to understand the foundations of human learning to enable effective learning, appropriate interpretation, and positive visitor experiences. When principles of learning are investigated in conjunction with the tenets of visitor management and mLearning, considerable opportunity arises for the application of mLearning in sustainable tourism to advance visitor learning outcomes in environmental education, interpretation, and conservation. Ultimately, the aim of applying a soft visitor

Table 2. Description of mLearning subject areas and article count.

mLearning category	Subject areas/research context	Article count/ percentage distribution	Author/s (year)
mLearning categories in tourism (THM) and environmental education (EES)			
THM	Tourism and hospitality related disciplines, including events management, heritage, culture, and culinary/food and beverage	5 (6%)	Bellotti, Berta, De Gloria, and Margarone (2003); Charitonos et al. (2012); Laine, Vinni, Sedano, and Joy (2010); Smith and Walters (2012); So et al. (2009)
EES	Environmental education and sciences, including ecological, conservation, nature, geographical, physical, and earth sciences	15 (19%)	Chang et al. (2012); Chang, Chen, and Hsu (2011); Chang, Sheu, and Chan (2003); Chu, Hwang, Tsai, and Tseng (2010); Hung, Hwang, Lin, Wu, and Su (2013); Hwang, Chu, Shih, Huang, and Tsai (2010); Laru, Jarvela, and Clariana (2012); Liu, Peng, et al. (2009); Liu, Tan, and Chu (2009); Rogers et al. (2010); Ruchter, Klar, and Geiger (2010); Sha et al. (2012); Sha et al. (2011); Uzunboylu et al. (2009); Yang and Lin (2010)
Studies not categorized into either the tourism (THM) or environmental education (EES) mLearning categories			
GML	General mobile learning (non-specific to a particular educational sector classified below)	14 (18%)	Caverly (2012); Crescente and Lee (2011); Hashemi et al. (2011); Liu et al. (2010); Lopez et al. (2009); Martin et al. (2011); Ozdamli and Cavus (2011); Revieu, Smeureanu, and Dardala (2009); Terras and Ramsay (2012); Wali et al. (2008); Wang and Shen (2012); Ward and Prosser (2011); Wong (2012); Wu et al. (2012)
GEP	General education and teaching pedagogy (not classified into any of the education sectors below)	6 (7%)	Casim and Yang (2013); Jeng et al. (2010); Sabaratnam and Ong (2013); Shanmugapriya and Tamilarasi (2012); Su et al. (2011); Westera (2011)
FES	Formal education, including early childhood, primary, and secondary education/schools	10 (13%)	Chang (2010); Echeverria et al. (2011); Gedik, Hanci-Karademirci, Kursun, and Cagiltay (2012); Kiger, Herro, and Prunty (2012); Looi et al. (2009); Nedungadi and Raman (2012); Shih, Chen, Chang, and Kao (2010); Wong, Chen, and Jan (2011); Wong, Chin, Tan, and Liu (2010); Zurita and Nussbaum (2004)

(*continued*)

Table 2. (*Continued*)

mLearning category	Subject areas/research context	Article count/ percentage distribution	Author/s (year)
HES	Higher education, including university, college, and vocational education and tertiary institutions/institutions of higher learning	20 (25%)	Alzaza and Yaakub (2011); Beckmann (2010); Cheon, Lee, Crooks, and Song (2012); Cochrane (2010); Cornelius and Marston (2009); El-Bishouty, Ogata, Rahman, and Yano (2010); El-Hussein and Cronje (2010); Evans (2008); Holotescu and Grosseck (2011); Hussin, Manap, Amir, and Krish (2012); Jones, Johnson, and Bentley (2004); Kuo and Huang (2009); Liaw et al. (2010); Liu, Tao, and Nee (2008); Motiwalla (2007); Oberg and Daniels (2013); Schwabe and Goth (2005); Shen, Wang, and Pan (2008); Shim, Dekleva, Guo, and Mittleman (2011); Vinu, Sherimon, and Krishnan (2011)
DCE	Distance education/learning, and community-based education	6 (7%)	Binsaleh and Binsaleh (2013); Fuegen (2012); Gronlung and Islam (2010); Hartnell-Young and Vetere (2008); Kim, Miranda, and Olaciregui (2008); Korucu and Alkan (2011)
APE	Adult education, professional education, and lifelong learning	4 (5%)	David, Yin, and Chalon (2009); Fallahkhair, Pemberton, and Griffiths (2007); Fischer and Konomi (2007); Sharples (2000)
Total		80	

management approach is to focus on the overall visitor experience and learning opportunities instead of simply emphasizing visitor impact (Mason, 2005). Soft (indirect) visitor management strategies mediate visitor behavior and effects through the use of persuasive communication, contextual understanding, positive visitor experiences, and satisfaction (Newsome et al., 2007; Weaver, 2008). Such strategies can augment hard (direct) management strategies (regulatory restrictions and infrastructural controls) to allow a holistic approach to managing visitors. As with any other type of management strategy, merely focusing on one type of management style is not recommended. An adaptive/flexible and balanced approach must be adopted to ensure desirable outcomes.

Additionally, the application of concepts and principles articulated earlier must be considered with regard to contextual and user-centric awareness when designing mLearning applications and interpretive content. First, the TILES model by Tan et al. (2009) calls for the amalgamation of five key contextual information features (temporal, identity, location, environment, and social), which are considered valuable to end users. For example, the weather, physical environment, and visitor type at a remote wetlands reserve would present significantly different conditions compared to an inner-city botanical gardens. It will thus require different visitor management and interpretive techniques to be applied at each site. Second, incorporating the mobile experience of tourists across the three stages of the tourism experience process becomes possible by synergizing the research done by Wang et al. (2012) and Watson et al. (2004). The three stages are (1) anticipating/planning, (2) the tourism experience, and (3) reflection/reminiscing. The four success criteria that should be considered are (1) attraction, (2) navigation, (3) acquisition, and (4) requirements at all stages of the visitor experience. From this perspective, visitor experience (and consequently, learning opportunity) is not limited to just encounters *in situ*; but instead, enables comprehensive and ubiquitous learning throughout (before, during, and after) the tourism experience.

This focus on the tourist consumption characteristics, suitability of content, and totality of the tourists' journey results in enabled visitors who are active participants and co-producers within the tourism experience (Liburd, 2005). Notably, much of the mLearning experience in tourism is considered free-choice/informal learning, wherein learning may be sporadic, accidental, or autonomous (Wang & Shen, 2012). Therefore, a firm connection between the visitors' psychosocial perceptions, sense of place, and interpretive experience must be present when designing mLearning for environmental interpretation to ensure sustainable learning outcomes, mindful visitor behavior, and appropriate destination representation.

Conclusions, implications, and future research

To enable the effective operationalization of sustainable tourism, an evaluation framework with sound measurement indicators must be established for accurate monitoring and meaningful assessment of outcomes toward achieving sustainability (Butler, 1999). Hence, this study was undertaken to establish a framework that would enable the assessment of mLearning outcomes in environmental interpretation and conservation. It is not interested in merely analyzing the technological usability or functionality of mobile applications but rather in the effectiveness of such mobile-driven applications as an interpretive tool toward specific conservation learning outcomes and the modification of future sustainable behavior, attitudes, and affirmative action.

To design effective interpretation and positive learning experiences, site managers must develop messages that will facilitate the connection among previous experiences,

on-site experiences, physical surroundings of visitors, and the core issues they interpret (Ballantyne et al., 2008; Liburd, 2005). The pre-visit environmental knowledge, mindset, interests, and motives of visitors must also be understood (Beaumont, 2001; Xu et al., 2013). Therefore, the content and messages of mLearning systems and applications must be designed with the visitor and learning conditions and/or context in mind instead of overly focusing on the technological aspects. Lopez et al. (2009) and Hashemi et al. (2011) articulated this need for a pedagogical and socially constructed focus, emphasizing that learning should not be technology-driven or be the only basis of evaluating effectiveness. Attention should instead be paid to the human−system interaction aspects, particularly within the free-choice/informal learning environment within which tourism experiences occur.

The results of the literature review and analysis of mLearning applications provide evidence that supports further work and opportunities for the expanded application of mLearning in environmental interpretation and visitor management for sustainable tourism. Technological, informational, and educational innovations available today can, and should be considered as part of an integrated system of communications in tourism to ensure visitor learning, future sustainability, development, and success (Ali & Frew, 2013; Liburd, 2005). Although the scope of literature and research covered in this study may not be a definitive collection or generalization of all works on mLearning undertaken to date, the present study presents valuable insights into the current issues, challenges, and trends within the subject area. Consequently, it suggests areas where existing gaps can be addressed. Future research can be undertaken through field investigation, with site- and visitor-specific evaluations of current mobile-driven interpretive programs and visitor experiences of mLearning to obtain empirical data for further analysis. The proposed conceptual framework and suggested measurement indicators can be suitably applied to a myriad of protected areas and interpretive programs, enabling the mLearning phenomenon and its outcomes for conservation to be further explored within the context of sustainable tourism.

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