Advancing Mobile Learning in Formal And Informal Settings via Mobile App Technology: Where to From Here, and How?

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ABSTRACT

In this paper a brief review of the framework that addressed mobile learning implementation challenges (pedagogical, technological, policy and research) that was developed by Khaddage et al. (2015) is briefly discussed, followed by possible solutions that could be deployed to tackle those challenges. A unique approach is then applied to bridge the gap between formal and informal learning via MAT (Mobile Applications Technology). This approach is based on STEAM (Science, Technology, Engineering, Art and Mathematics) as subjects to be taught and the specific skills needed to achieve the RLOC (Required Learning Outcome) that can support student learning informally. This specific approach shows HOW to advance mobile learning in formal and informal settings.

Keywords

Mobile learning, Mobile apps, Informal learning, Challenges, STEAM, Mobile solutions

Introduction

Mobile learning (or m-learning) as a concept and theory has evolved rapidly, and it is no longer considered just a technocentric trend, attractive for those interested in devices and technologies. This becomes obvious due to the increased reception of mobile learning in reviews on current trends in education (e.g., Johnsson, Levine, Smith, & Stone, 2010). The most recent discussions tend to assert there has been a shift from defining mobile learning as based on the devices used (Soloway et al., 2001) towards the inclusion of context (Sharples, Taylor, & Vavoula, 2007, p. 4). Mobile learning is accepted to represent a technological advance, enabling rich, distributed and contextualized approaches to learning (Crompton, 2014). Moreover, it is accepted that m-learning is about the learner's mobility, and how we as educators can engage students and in learning activities without them being restricted to a physical location. Nevertheless, it seems that the understanding of mobile learning and m-learning is still evolving, and that there are several considerations that should be included in trying to define the term. Specifically, an educationally relevant definition of mobile learning seems to be required (Laouris & Eteokleous, 2005). Along this line, Crompton, Muilenburg, and Berge's define m-learning as "learning across multiple contexts, through social and content interactions, using personal electronic devices" (Crompton, 2013). The authors would like to extend that definition by including notions of agency and timeliness, in the following way: "Mobile learning accommodates and supports personal agency of the learner in a way that the learner can decide when, where and how he or she will learn; as such, mobile learning is instrumental in just in time and on demand learning." With this definition, we summarize notions of several research sources (Baker III, 2016; Boese, 2016; McLean, Attardi, Faden, & Goldszmidt, 2016).

A major potential of mobile technologies for learning lies in the ability to provide timely access to learning in authentic working contexts (Herrington et al., 2012; Herrington, Ostashewski, Reid, & Flintoff, 2014). Chan et al. (2006) coined the term *seamless learning* for this, which they define as the "ubiquitous access to mobile, connected, personal, handhelds creating the potential for a new phase in the evolution of technology-enhanced learning, marked by a continuity of the learning experience across different environments." However, this relates to the challenge of finding appropriate and effective methods to blend formal and informal learning, as seamless learning can occur anytime – in-classroom, or outside the classroom, in formal settings, or incidental within a peer group. The corresponding challenges can be classified into four categories: *pedagogical challenges, technological challenges, policy challenges and research challenges* (Khaddage et al., 2015). Evolutionary change usually takes place in response to ecological interactions that operate on the overall ecosystem, Zhao and Frank (2003) suggested that the process of technology integration is evolutionary, and they stated that pedagogy, and technological skills slowly build upon each other and evolve as technology is introduced into the learning environment. Therefore these four challenges, enabling the understanding of the structure and function of each one of them. Understanding the relationships between these challenges is essential for a proper mobile learning integration and a successful mobile learning ecology (Zhao & Frank, 2003; Khaddage et al., 2015).

The adoption, support and integration of mobile learning was also a topic at the Fourth International Summit on ICT in Education (EduSummIT 2015), which was held in Bangkok, Thailand, members of the Thematic Working Group 2 (TWG2) discussed methods, strategies, and guidelines for issues and challenges in the design, implementation, evaluation, and policy development of mobile learning. Some major key challenges were highlighted and discussed along with issues that policy makers, teachers, researchers, and students are facing in mobile learning. A theoretical framework for mobile learning emerged during EduSummIT 2013 (Khaddage et al., 2015), which identified barriers and limitations along with dynamic criteria for mobile learning implementation. This paper presents results from discussions at this summit, reviewing the framework's major challenges, and identifying possible solutions that could be applied to solve these challenges.

Background

New technological innovations have often been attributed with the potential to have a large impact on the field of education. For instance, when film was first used in instruction in 1913, Thomas Edison was optimistic of the potential that this could bring to education and he claimed then that "*the motion picture is destined to revolutionize our educational system and that in a few years it will supplant largely, if not entirely, the use of textbooks"* (Cuban, 1986, p. 9). Although instructional films did contribute a great deal in some military training (Noble, 1991), films have never replaced the traditional book. ICT and computers came up with similar optimistic promises for revolutionizing the classroom, which so far apparently have not been fulfilled. The question remains as to why mobile technologies and the concept of mobile learning could provide a similar successful concept, revolutionizing education as the introduction of books did some 2000 years ago, despite the also apparent critiques at that time.

So far, it is apparent that despite the results presented from many research studies such as Ooms et al. (2008) followed by Attewell, Savill-Smith, Douch, and Parker (2010) and many others who identified the positive effects on engagement from the introduction of mobile and handheld technologies, and the positive impact of mobile technologies integration in general – the fusion of mobile technologies into educational settings has not yet been widely adopted. Many teachers in schools and colleges are still reluctant to allow widespread access to mobile devices in a formal classroom setting (Khaddage, Lanham, & Zhou, 2009), often for reasons of lack of control of student activities and general safety concerns. This has resulted in many students being bored in classrooms and has added to the already high dropout rate, since today's students would favor an engaging, creative and collaborative learning environment (Bonk, 2009), and mobile technologies could help in setting up such environment (Khaddage et al., 2009). Many students feel that the materials provided are somehow irrelevant for them, not engaging and do not satisfy their needs, as these materials are outdated and do not fit into today's society (Knezek, Lai, Khaddage, & Baker, 2011; Khaddage, Knezek & Baker, 2012).

What is emerging now is a class of mobile applications that support synchronous collaboration: so called Social 3.0 apps. Examples of such apps include those with Web 2.0 support and asynchronous collaboration (e.g., SMS, Twitter) while Social 3.0 supports synchronous collaboration (e.g., Google Docs Editor). Upon reflection it is not surprising that schools and particularly teachers do not really show much interest in any technology (e.g., synchronous collaboration technology); their objective is pedagogical impact, and technologies as such are just understood as a means to achieve this, e.g., to facilitate social learning. As such, technologies such as mobile apps will still have difficulty finding their way into the primary/secondary classrooms and becoming a valuable component of the curriculum, until they provide an added value from the perspective of the responsible teachers and school administration, and until the introduction of such technology into the classroom is no longer tied with obstacles to overcome, such as technological problems, additional technical skills, and further challenges with respect to privacy and security issues. The question remains as to whether mobile learning is finally poised to make the level of impact on teaching and learning that mobility is having on most other areas of human endeavor? The rise of the Internet of Things (IoT), the scope of m-learning and apps are poised to be redefined in a very significant way. Wearable devices and IoT interactions introduce a whole arena of new considerations, and all of these combined poise challenges on informal learning. These challenges are summarized and illustrated in Figure 1, and are discussed in more detail in Khaddage et al. (2015).

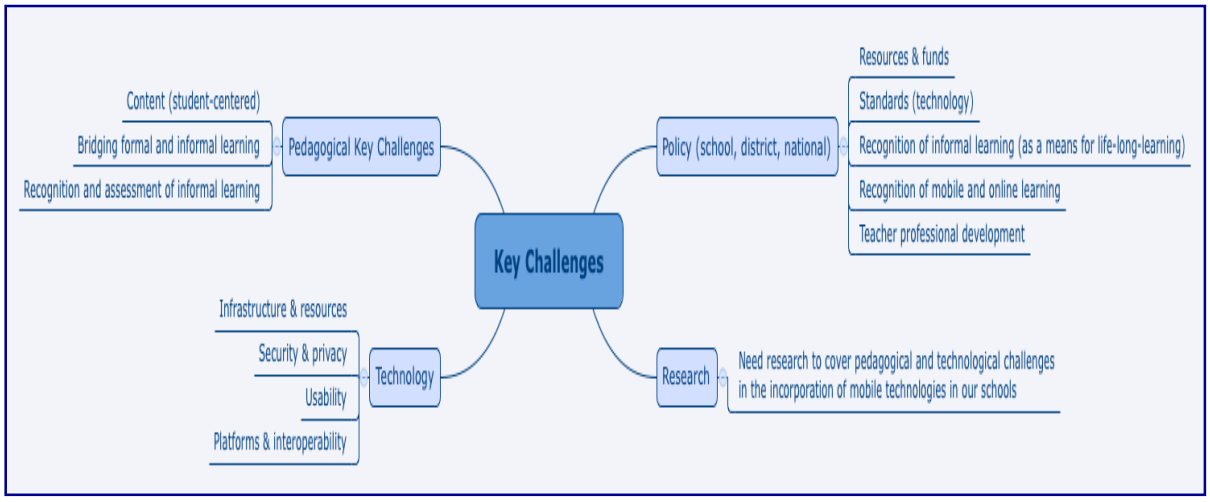

Figure 1. Key challenges facing informal learning

Key challenges for informal learning

Informal learning lacks a clear definition, and it is often being explained by contrasting it with formal learning (Marsick & Watkins, 2001). Thus informal learning is often used synonymously with non-formal learning. Also, the boundaries between informal and incidental learning seem to be blurry. There exists agreement that informal learning represents learning that takes place outside of formal learning and educational establishments, that informal learning does not follow a specified curriculum and that it is not necessarily pedagogically planned or organized (McGivney, 2006). More concisely, the distinction between formal and informal learning can be seen in the presence or absence of a formal curriculum and the frequency with which we visit the places where learning occurs. (Looi et al., 2016).

A major part of learning takes place outside of formal learning. This is well known in adult learning (McGivney, 2006), but also applies to children and young people. Therefore it is possible to consider that school is simply one context for learning and that formal and informal learning can occur within and outside of school and institutional settings. In some ways informal learning could be considered autodidactic, or indeed incidental (Kerka, 2000), non-formal, or random (Connal & Sauvageot, 2005) learning, but some of these terms have inherited a negative connotation and are discouraged by some scholars. For the purposes of this paper the most significant differentiation between formal and informal relates to who determines the what, where and when of learning, i.e., is an accrediting body defining the required learning (formal) or not (informal).

Information technology and computers specifically allow children and young people a wide variety of activities and experiences of informal learning. It has been suggested that these hold the promise of transforming the nature of education, possibly leading to a "wider ecology of learning," by changing the scope and the nature of learning, providing opportunities for learning new kinds of skills, and offering different and new ways of learning traditional knowledge (Sefton-Green, 2004). In this context, mobile learning represents a modality that very naturally integrates, bridging naturally the domains of formal and formal learning with its applicability in both domains, representing the basis for a perfect personalized learning environment (PLE; van Harmelen, 2006), and apparently providing the perfect learning tool for both formal and informal modes.

Still, acknowledging such informal learning represents a challenge faced by societies and by schools in particular. Griffiths and Peñalvo (2016) discussed the difficulties in recognising informal learning such that the requirements of formal settings do not formalise the learning; and they discussed ways of bridging both modes in an effort to enhance engagement in both modes through an awareness of each (Griffiths & Peñalvo, 2016).

Valuing informal learning should be a crucial element to consider when developing and adapting educational policies. So far only a few countries (such as South Africa and Ireland) award credential based on knowledge gained via informal learning, while the rest still have no formal policy framework for this type of learning (Werquin, 2010). However, there also exists an inherent risk that approaches to recognising informal learning lead to restrictions that

might again formalise the learning, such as the requirement of formal settings. At first sight, the issue of acknowledgement of informal learning seems not connected to the field of mobile technologies and learning. However, any assessment of learning gains is always connected to a corresponding documentation of competency development. Mobile devices as a central computing and communication device provide the opportunities to log learner performance on a regular basis, thus providing a perfect basis for the assessment and honoring of user skills.

From the point of view of formal education, it is also tempting to try to extend learning outside the classroom and to connect to informal and incidental learning. Once again, this should not introduce new restrictions and obstacles, hindering informal learning. Instead, approaches should be sought and required that ease linking of formal and informal learning phases, and which foster the transfer of acquired knowledge and skills.

In the following section we will address more precisely the recommendations and possible solutions to the identified challenges, as a new approach that can map informal and formal learning strategies to real work. The authors propose that mobile technologies can bridge the gap between informal and formal learning via application of the MAT (Mobile App Technology) model (Khaddage, Knezek, & Baker, 2012).

Recommendations and possible solutions

Making informal learning a valued and visible component of the education system is very important. Hence, schools should re-evaluate the current educational framework and determine how best to merge it seamlessly with informal learning. Informal learning should be embedded in educational contexts by training teachers via professional development on how to help learners share knowledge gained through informal learning activities and tasks. Schools should let teachers see the potential of this sharing and collaboration activities amongst learners. This may help to broaden the acceptance of this type of learning. Figure 2 illustrates possible solutions to the identified challenges.

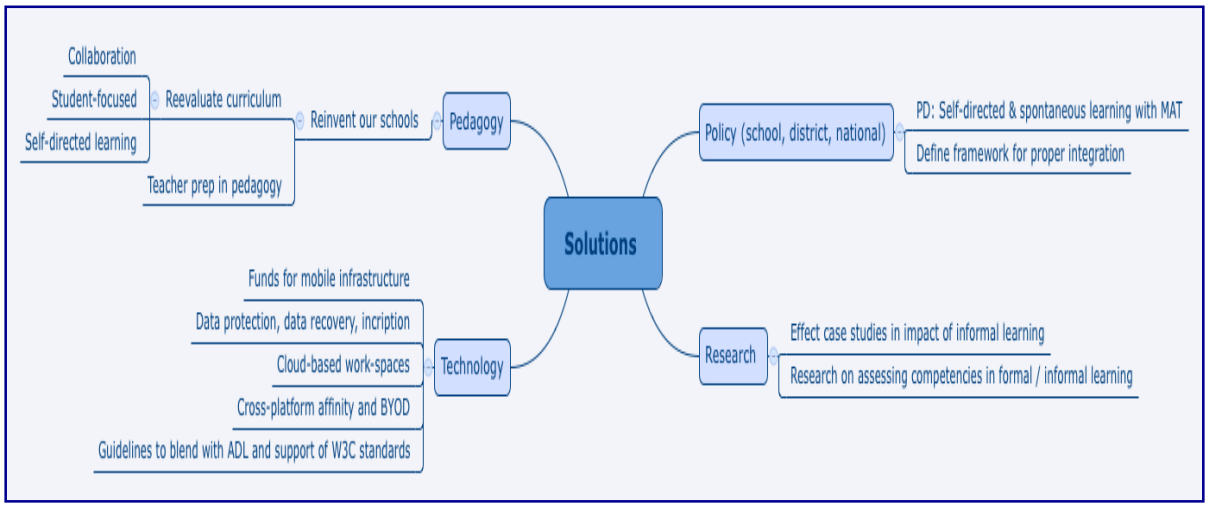

Figure 2. Solutions to the identified challenges regarding informal learning

Solutions for informal learning can be categorized according to the types of the identified challenges in Figure 1. In the field of pedagogy, the major challenge is in preparing and opening schools for innovative learning opportunities incorporating informal learning. We summarize this challenge to "reinventing our schools." This includes a reevaluation and development of school curricula to allow for more collaborative learning activities, student-focused learning, and self-directed learning. All of these we understand as preconditions for a better linking to informal learning. At the same time, these strategies also support novel learning activities that exploit the potentials of ICT and mobile learning technologies specifically. In addition, teachers and schools need to get prepared to handle the challenges and to exploit the opportunities associated with both informal learning and mobile learning. A specific aspect in this context is the enhancement of awareness of the values of both worlds of learning, formal and informal – on the side of teachers, and, in the end, also the students' sides – in order to enhance an engagement in both domains and to foster a bridging of both modes of learning (Griffiths & Peñalvo, 2016).

Technology represents the second area of challenges. While we would like to argue that mobile technologies represent a major innovation enabling new forms of learning, further challenges exist. On a very practical level, current school infrastructures typically do not fulfill the requirements to allow for a seamless integration of mobile learning. In addition to relating at the level of school policies (e.g., allowing the use of personal mobile devices in the classroom) this also relates to the availability of appropriate technological infrastructures (e.g., connectivity and bandwidth to allow for a parallel connection of up to 40 devices in parallel in a classroom); this is also a question of appropriate funding and technological support. Further challenges relate to availability of technological infrastructures on a more general level. Cloud infrastructures represent a further requirement to allow for a seamless exchange of learning material and information between teachers and learners and within learner communities. In addition, accepting private devices at schools (e.g., BYOD: Bring Your Own Device) requires a certain level of standardization and interoperability, e.g., with standards from W3C, to allow for a seamless integration on class activities. These standardizations on a technological level seem to be a necessary requirement for an efficient and effective integration for both, classroom usage and usage for informal learning.

On the policy level, we see different challenges, which may be further distinguished on a school level, regional level, national level, and even international level. As mentioned before, novel approaches for honoring the increase of skills and performances from informal learning are required. Corresponding frameworks are required also.

Finally, we also need further efforts in research which is required, namely in the areas of effect case studies in impact on informal learning, and on the acquisition of competencies, both in formal and informal learning, based on comparison studies.

Figure 2 also depicts the massive change that needs to take place in order to find solutions to the existing challenges, and provides readers an overview of the big picture regarding what aspects need to be addressed on the different levels of pedagogy at schools, technology, policy, and research. It represents a bottom up approach that requires solid implementation from the foundation level to cover all levels of the school hierarchy. This may involve all stakeholders on different levels, such as students, administrators, teachers, policy makers, researchers, curriculum developers, IT designers and developers, parents, principals, coordinators, and others.

What we have been witnessing so far is that the current zeal around mobile application solutions sometimes distracts schools from the meaningful purpose of mobile integration; that is being portable, interactive, engaging, on demand, collaborative etc. (Benham et al., 2014). This is because some schools do not follow the bottom up approach by starting at the foundation level and covering all aspects, as proposed in Figure 2. Instead schools tend to bring in and integrate the technologies and deliver the same static content without any changes to existing traditional methods. Examples of such approaches are numerous – such as the many iOS/iPad projects worldwide, where some schools brought in specific mobile devices to deliver the same static content (Khaddage, 2013; Lai, Khaddage, & Knezek 2012).

Bridging the gap via mobile app technologies

The way schools provide and deliver teaching and learning should change to cater for the demand of our iterating and mobilized society. Mobile learning gets positioned as the enlightened and “correct” solution for the modern school settings, and can if applied seamlessly bridge the gap between inside class/ formal learning and outside class or informal learning (Kukulska-Hulme, 2007; Sharples et al., 2005). Currently one of the most flexible and portable ways to access information is via mobile technology and devices, and in particular via apps and social networking. Mobile social networking apps are being used as informal learning spaces in collaborative learning environments (Crompton 2013; Khaddage et al., 2015). Educators and schools have become interested in the application of mobile learning via apps that bridge the gap between formal and informal learning, in an effort to extend their reach into spaces and times that have previously been regarded as outside the scope of formal education. Such approaches offer opportunities to flexibly deliver learning content that complements formal class settings.

While figure 1 is a representation of the big picture and illustrates a general overview of the change in education, we try to sketch a possible approach on a more concrete level that could be implemented by schools to bridge the gap between formal and informal learning, based on evidence from the current research. This approach is proposed as being capable of offering informal learning effectively and efficiently.

Researchers in ICT (Information and Communication Technology) in education have been reporting for years that formal learning is getting boring and this is resulting in dropouts in schools. Formal learning is slowly disappearing, as it follows a static linear and routine approach that the 21 century digital native learners find boring and no longer useful (Voogt, Knezek, Cox, Knezek, & ten Brummelhuis, 2013). Some would argue that both formal and informal learning are valuable for gaining skills and obtaining knowledge (Billet, 2001). Other researchers have shown that strong foundation skills allow learners to make the most of their informal learning (Nordman & Hayward, 2006). They suggest that informal learning may not be useful to those without such a foundation. The authors believe it is crucial to find a unique approach capable of bridging the gap between formal and informal learning via mobile technologies and applications. As we see from the literature, there is no doubt that new technological innovations are changing the whole ecosystem and the economic direction; hence changing our education system.

In Table 1 the authors propose a unique approach based on STEAM (Science, Technology, Engineering, Art and Mathematics) since the main themes of STEAM are fostering innovation, the need for twenty-first century skills, and divergent and convergent thinking amongst learners (Kim & Park, 2012). Schools could identify *Subjects* to be taught and the *Skills* along with the *Required Learning Outcome (RLOC)* that can support student learning. As seen in Table 1 subjects are categorized, and skills with the RLOC are identified. This may vary from school to school, depending on the subjects being taught. But for an illustration of how this method would work, the focus is on STEAM subjects, to show the categorised list and use it as a benchmark.

Instead of generalizing and following the same approach for all subjects, we present a flexible approach that could be altered depending on the subjects and skills, and could bridge the gap between formal and informal learning. The main focus is on the skills that students need to gain in order to address the RLOC rather than the subject itself, and then on applying the appropriate methods to support using innovative mobile technology, in an attempt to advance mobile learning in formal and informal settings. This method is to focus on the important skills we want students to gain from studying those STEAM subjects: Science, Technology, Engineering, Art, and Mathematics. Do they all demand a singular approach to developing skill and capability necessary so that RLOC are met for each particular subject? Is formal learning or informal learning the most appropriate method for ALL of the skill types? Of course the answer would be NO.

Table 1. Subjects are categorised and skills with the RLOC are identified

	Subjects				
	Science	Technology	Engineering	Art	Mathematics
Skills and RLOC	Observation	Coding	Assessment and estimation	Perseverance	Problem solving
	Collecting and interpreting data	Logical thinking	Assembly and awareness	Focus	Analysing, estimating,
	Making models	Creativity	Teamwork and leadership	Collaboration	Measurements
	Measuring and predicting	Computation	Analytical and adaptability	Dedication	Interpret and processing information

Now we can classify the skills from STEAM that could be gained via a formal setting versus those skills that could be gained in informal settings. MAT (Mobile App Technology) is applied to see how it can be used in order to advance mobile learning in formal and informal settings. This is briefly illustrated in Table 2.

Table 2. Formal settings skills versus informal settings and MAT application

	Type of learning and MAT		
	Informal learning	Formal learning	Some (MAT) that can be used
Skills and RLOC	Estimation, observation collecting data	Coding interpreting data	Mobile cloud-based apps
	Teamwork collaboration	Logical thinking	Social spaces on mobile apps
	Making models and creativity	Leadership and adaptability	Hybrid mobile apps
	Measuring and predicting	Computation	Native mobile apps

As shown in Table 2, some of MAT that can be used could be applied to bridge the gap between formal and informal learning to help students gain the required specific skills. Students can use mobile app technologies to demonstrate a variety of tasks. Apps come in different types, hybrid, native, web/or cloud apps. The list below identifies each type:

- **Hybrid apps:** are cross-platform and combine both characteristics of native and web/cloud apps, they run on the device itself, but they run inside a native container within the operating system of the device itself (Mudge, 2012; Khaddage et al., 2015)
- **Native apps:** are device specific and operating system specific, they are most suitable for gaming, as they provide high quality graphics and speed since they run within the device engine, thus making them the most engaging robust apps (Korf & Oksman, 2012).
- **Web/Cloud apps:** they are server side apps (cloud-based or web-based), are device independent and run on all platforms. They only use the browser of the mobile device and they support BYOD (Bring Your Own Device) (Boulos et al., 2011; Khaddage, 2013).

Khaddage and Knezek (2012) discussed how the use of already-existing educational apps is important and can be used to empower informal learning. Many authors have described and discussed methods of mobile technology integration (Boden, 2001; Candy & Edmonds, 2002), and how it improves creativity, collaboration and engagement amongst students. Khaddage and Knezek (2012) stated that students can use mobile apps to demonstrate a variety of tasks in formal and informal settings. They described the benefits that can be offered, as illustrated in Figure 3.

Figure 3. Skills learned via mobile apps (Khaddage & Knezek, 2012)

Students can use some of the already existing educational apps to complete learning activities. By using mobile apps, these tasks could be performed anywhere and anytime and the RLOC for any specific subjects could be met. But the issue is how to get this acknowledged and recognized by teachers? This proposed unique approach can be considered as one solution, especially when schools ensure that those mobile apps' initiatives for teaching and learning are aligned well with subject objectives and the RLOC as listed in Table 1. Then those mobile apps could be used across variety of subjects in and outside of classrooms. These mobile apps are capable of running on the learner's mobile device to deliver learning that can offer skills in a hybrid/blended-learning environment, where the main focus is on the required skills regardless of how they are obtained, formally or informally. For example, with the advent of the mobile phones and apps, informal learning can now take place in mobile cloud space, in hybrid mobile apps, and in social networking spaces, as illustrated in Table 2. Virtual meeting points can be created where learners can collaborate with each other via apps on their phones (Fotouhi-Ghazvini et al., 2009). Learners can learn across spaces via apps and virtual interaction. They can communicate, engage and create, then gain ideas and learning resources that they obtained in one location and apply or develop them in another – and that could be in class in a formal setting (Sharples et al., 2005). By doing so, this gap between formal and informal learning can be bridged with MAT, thus forming a new and innovative learning setting that can be hybrid, dynamic and synergetic. It is also important for schools to design and integrate tools and devices that can be used across subjects in classrooms, thus allowing flexibility and portability (Khaddage & Knezek, 2012).

While there are indications of the educational transformation possible with informal learning, particularly with MAT integration, more needs to be understood about this phenomenon. The change should start at the government level by re-allocating more funding for informal learning initiatives, including academic studies to pinpoint the benefits of this type of learning.

A review of published literature on mobile learning highlights the fact that informal learning is indeed possible with mobile apps (Jones et al., 2006; Scanlon, Jones, & Waycott, 2005; Clough Jones, McAndrew, & Scanlon, 2007; Khaddage, Knezek, & Baker, 2012). The only limitation to mobile app integration for informal learning is that it can be difficult to capture informal learning when it occurs, and there are no common key performance indicators against which to measure the progress of learners. But the opportunities to evaluate the skills and RLOC of informal mobile learning have increased with the wide availability of tools and technologies, combined with easy access to Internet via Wi-Fi and 3G. There is also an increase in the number of educational apps for different platforms, although iOS is still leading in terms of the total number of native educational apps available on any platform (Mobile matters). This is largely the result of some schools teaming up with Apple for mobile technology integration. Higher Colleges of Technology iPad initiative is one example of such integration in an effort to offer a flexible informal learning environment (Khaddage, 2013).

Innovative practices and future considerations

When it comes to design challenges of mobile learning, leading mobile apps are delivering exceptional user experiences (UXs) achieved with a variety of techniques including motivational design, “quiet” design, “playful” interfaces and new methodological approaches (Gartner, 2015). Designers are also creating apps that can accommodate mobile challenges, such as partial user attention and interruption, or exploit technologies with novel features in an attempt to hook the learner into using the technology to complete the learning task. All these newly developed apps do support STEAM subjects and offer a challenging informal learning environment. A good example of this is augmented reality and virtual spaces via mobile apps. According to Gartner (2015), by the year 2020, an affluent household will contain several hundred smart objects, including domestic appliances, sports equipment, medical devices and controllable power sockets. These domestic smart mobile objects will be a part of the Internet of Things (IoT), with the majority of them being able to communicate in some way with an app on a smartphone or tablet. Smartphones and tablets will perform many functions, including acting as remote controls, displaying and analysing information, interfacing to social networks to monitor “things” that can tweet or post for learning activities and tasks informally. This combination of smart objects and mobile apps and technologies will enable an even wider range of informal learning opportunities (Gartner, 2015). So far only a small number of smart objects and appliances are available in 2015, such as sensors. However, the range of domestic smart objects will continue to grow. How this will affect the learning environment in informal settings is still not clear, as new technologies bring along new issues. Wearable technologies such as watches displaying email and messages via an app on those devices will pose new security and management challenges. Devices that can record video will raise many privacy concerns, as has been demonstrated by Google Glass. Schools are still fretting about mobile learning policies as well as pedagogies, research and technologies, and they are struggling to find ways of proper integration. It is crucial for schools to advance in their offering and how they deliver the learning content; otherwise they are going to be left behind. Hopefully the proposed approach/solution in this paper, if deployed properly, may help in solving the identified key challenges and help in preparing schools to find unique approaches to blend informal learning seamlessly into their existing settings.

Conclusion and future work

When bridging formal and informal learning, schools should not be aiming to unintentionally formalize informal learning, but rather they should be looking to find unique methods and approaches to incorporate mobile learning and blend it seamlessly into their settings to create an engaging informal learning environment. The approach proposed in this paper could be used as a good starting point. While there are potentials with informal learning and particularly in low resource contexts, more research is needed to further understand this shift in technology and in educational settings (formally and informally). More funding for informal learning initiatives should be made available in order for educators, researchers, policy makers and practitioners to highlight the value and benefits of

this type of learning. The continuous and consistent work of EduSummIT's Thematic Working Group 2 via the application of the mobile learning framework (see Khaddage et al., 2015) to challenges identified is considered useful techniques that can be used to test the ecological theory in the mobile learning framework. The unique approach proposed here that combines skills RLOC and the inclusion of STEAM to test MAT, could be considered a first step towards bridging this gap between the two types of learning (formal and informal), in an effort to keep advancing mobile learning in all different settings, shapes and forms, and hence assisting researchers, policy makers and educators in the practical implementation within a mobile learning environment.

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