Seamless Learning: An International Perspective on Next Generation Technology Enhanced Learning

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Abstract
In this chapter we present and discuss the results and reflections based on our recent developments and experiences in Europe and in Asia regarding how novel educational design patterns, mobile technologies and software tools can be combined to enhanced learning. We propose and recommend possible directions for the design of future educational activities and technological solutions that can support seamless learning. To the end, we discuss how the notion of seamless learning could be used to tackle some of the challenges our educational systems are facing in connection to the introduction of mobile technologies into classrooms settings, innovative educational practices and sustainability.

1. The Evolution of Technology Enhanced Learning

Personalized learning has been a goal for education during the past 40 years: to provide access to learning resources and activities that adapt to the needs and abilities of the learner (Dodd, Sime and Kay, 1968). Mobile technologies can now offer adaptivity to the physical and social settings and their use and adoption in education has generated a new approach for technology-enhanced learning called mobile learning or *m-Learning* (Sharples et al., 2009). The rapid development of these technologies combined with access to content in a wide variety of settings allows learners to experience new learning situations beyond the classroom. Cross-contextual learning can enable a continuous learning experience across different settings, such as home-school, or workplace-college. This new view on technology-enhanced learning (TEL) supported by wireless technologies and ubiquitous computing is termed Ubiquitous Learning or *u-Learning* (Rogers et al., 2006; Syvänen et al., 2005). While context is an important aspect of mobile learning, it is the core concept of u-learning, due to two important affordances of the learning environment, namely *context awareness* and *adaptivity*. By *context awareness* we mean that the system providing pedagogical flow and content to the learning environment should be *aware* of the learner's situations. By *context adaptivity* we mean that different learning contents should be adaptable to the particular setting in which the learners are situated.

Mobile and ubiquitous TEL offer the potential for a new phase in the evolution of the field, marked by a continuity of the learning experience across different learning settings. Chan and colleagues (2006) use the term *"seamless learning"* to describe these new situations. Seamless learning implies that students can learn whenever they are curious, in a variety of situations. They can easily and quickly switch from one scenario to another using their personal mobile device as a mediator, and can maintain the continuity of their learning across technologies and settings. These scenarios include learning individually, with another student, a small group, or a large online community, with possible involvement of teachers, relatives, experts and members of other supportive communities, face-to-face or in different modes of interaction and at a distance in places such as classroom, outdoors, parks and museums, or on cyberspace such as in virtual worlds and social networking spaces. Recent studies on seamless learning have been extending from teacher-facilitated classroom or outdoor learning into nurturing autonomous learners. Indeed, the ultimate motivation for learning scientists to promote seamless learning is to foster the habits of mind and abilities that support 21st century skills among students (Anastopoulou et al., 2012). The aim is to design and enact not just episodic activities but ongoing programs to gradually transform learners into more self-directed individuals being able to carry out learning tasks not just anytime and anywhere, but perpetually and across contexts with and without external facilitations. Mediated by technology, a seamless learner should be able to explore, identify and seize boundless latent opportunities that her daily living spaces may offer, rather than always being inhibited by externally-defined learning goals and resources (Wong, Chen & Jan, in-press). More research is certainly needed to improve our knowledge to better facilitate the nurturing of seamless learners, as well as its technological support. It is necessary to further investigate how students interact with learning contents, peers, teachers and parents through a variety of technologies and contexts (Wong & Looi, 2011).

The authors of this chapter bring together expertise in Learning Sciences and Human Computer Interaction to present and discuss the results of research experiences and projects conducted in Japan, Singapore, Sweden, Taiwan and the United Kingdom. The main purpose of our current common efforts is to achieve synergy and research efficiency especially in exploring and identifying how mobile technologies are nowadays shaping and creating innovative ways to share and construct information and knowledge in both formal and informal learning settings.

Our main contributions to this chapter are based on reflections upon our recent developments and experiences in Europe and in Asia regarding novel educational design patterns, technologies and tools to enhance learning. Having these points in mind, we propose and recommend possible directions for the design of future learning activities and technological solutions that can support seamless learning. To the end, we will discuss how the notion of *seamless learning* could be used to tackle some of the challenges our educational systems are facing in connection to the introduction of mobile technologies into classrooms settings, innovative educational practices and sustainability.

2. Characterizing Seamless Learning

The notion of *seamless learning* (Chan et al., 2006; Wong & Looi, 2011) which attempts to capture the opportunities for supporting learning across a variety of contexts offered by technological advancements in mobile computing and wireless communication has been used for inspiring the efforts that will be described in details in section 4. These include learning outside the traditional classroom and learning across formal and informal contexts. The exploration of new physical contexts mediated by technologies certainly requires specific considerations about technological affordances, but also about the social and pedagogical arrangements for the activities. There are two main important features that characterize seamless learning; namely *seamless adaptivity* and *seamless connectivity.* Seamless adaptivity implies that the *technology adapts* to the learner without the learner being aware; for example, learning content or services that are appropriate to the learner and settings (in the learner’s language, at the right level of difficulty, providing appropriate help, etc). Seamless connectivity enables the continuity of the learning experience by maintaining the learning across devices and settings, enabling learners to carry on where they left off, and to easily re-establish a learning activity from a previous time, by providing means to search back in time for a learning content or activity and then recall its context and connection.

Despite many promising TEL developments such as the introduction of interactive whiteboards and personal (1:1) computing in the classroom, there is still a need to improve our knowledge in this field in order to better support the design of activities inspired by the educational qualities that have been identified in previous research related to seamless learning. For example, it is necessary to further investigate how students interact with learning materials, peers, teachers and parents through a variety of technologies and contexts (Looi et al., 2010). Wong and Looi (2011) have recently suggested ten different dimensions characterizing activities for mobile-assisted seamless learning (MSL) as described below:

(MSL1) Encompassing formal and informal learning;
(MSL2) Encompassing personalized and social learning;
(MSL3) Across time;
(MSL4) Across locations;
(MSL5) Ubiquitous access to learning resources (online data and information, teacher-created materials, student artifacts, student online interactions, etc.);
(MSL6) Encompassing physical and digital worlds;
(MSL7) Combined use of multiple device types (including "stable" technologies such as desktop computers, interactive whiteboards);
(MSL8) Seamless switching between multiple learning tasks (such as data collection, analysis, and communication);
(MSL9) Knowledge synthesis (a combination of prior and new knowledge, multiple levels of thinking skills, and multi-disciplinary learning);
(MSL10) Encompassing multiple pedagogical or learning activity models.

(Wong & Looi, 2011; MSL5 as revised by Wong, 2012)

These ten dimensions align well with many of the educational objectives and values expressed in National documents for schools in Taiwan, Singapore, Japan, Sweden and the United Kingdom. The projects and activities described later in section 4, will show how we have included these dimensions in relation to the design of the learning activities. It is important to mention that design considerations should also take into account the technological affordances and their functionalities that depend on the pedagogical and social features of the learning activities, as well as the characteristics of the subject matter. Within the subject domains of science, mathematics and language learning, technological and pedagogical design choices have to be considered not only with respect to the qualities described in the dimensions of MSL but also with respect to the learning objectives of specific subject matters and the corresponding recommended learning trajectories.

3. Challenges in Pedagogical and Technological Design Associated with Seamless Learning

The vision of transforming learning practices with new technologies has not yet been fully crystalized, especially with regard to enabling learning and collaboration across contexts. The effort of designing effective computer support along with appropriate pedagogy and social practices is more complex than imagined (Stahl, 2002). There is no easy solution to the development of systems and technological tools to mediate autonomous and social learning in seamless learning environments. Such technological solutions must be able to support individual learners in bridging their ongoing learning processes across contexts, as well as connecting multiple learners within the same learning community but separated by time and (physical or digital) spaces. An even greater challenge lies in how to shift the epistemological beliefs of individual learners (as well as teachers who are to facilitate seamless learning) from absolutism and transmissionism to constructivism and socio-constructivism. This is because genuine seamless learning is about treating all the learning spaces and resources that learners have access to as ingredients to facilitate their ongoing self- and co-construction of knowledge, rather than believing in knowledge as composed of universal facts that are best to be learned through didactic teaching. Inquiry learning, distributed collaborative learning, authentic learning, and participatory learning are some of the approaches that can be enacted to nurture the habit of minds of seamless learning among learners.

Indeed, it is crucial for researchers and practitioners to find effective ways to design, implement and evaluate innovative learning environments and technologies in a wide variety of learning settings. Some of the current design challenges faced by seamless learning researchers and practitioners can be listed as follows,

- *How to design seamless learning activities that support innovative learning practices?*
- *How to design seamless learning activities that integrate learning across informal and formal settings, with the eventual aim of nurturing autonomous learners?*
- *How to design learning activities that reflect the cultural diversity of learners?*

- *How to assess seamless learning in these new educational contexts?*

Another significant issue pertains to the integration of software components in distributed environments (e.g., device- versus cloud-based) and also across a variety of software with new hardware and peripherals (e.g., sensors), as well as the support for content delivery and learner artifact creation on diverse types of devices used across different *learning* contexts.

4. Exemplars of Seamless Learning Activities in Asia and Europe

During the last five years we have been conducting research activities that explore new design approaches and innovative uses of social media, wireless and mobile technologies in a variety of collaborative and inquiry-based learning settings (Hwang, Tsai, & Yang, 2008; Hwang, Shi, & Chu, 2011; Kurti et al., 2008; Looi et al., 2010; Milrad et al., 2011, Ogata et al., 2010; Sharples et al, 2007; Wong, Chin, Tan & Liu, 2010). Our approaches are not simply characterized by the provision of novel uses of rich digital media combined with mobile and wireless computational systems and tools, but also by the exploration of new and varied learning activities that become available while applying innovative approaches for designing new technological solutions and utilizing existing ones to support seamless learning. This section presents a number of exemplars related to seamless learning projects that show how learning can be supported across a variety of contexts, how students can be helped to explore the physical environment, and how mobile and ubiquitous technologies can be used to facilitate conversations for learning.

4.1 Inquiry-based Seamless Learning Project in Taiwan

To investigate the effects of mobile learning and assessment strategies on students' in-field inquiry activities, a four-year national project was initiated in Taiwan in 2008 (Hwang & Tsai, 2011). In each year, there were nearly 1500 students participating in the learning activities of this project. Figure 1 shows the Chiku ecological conservation area located in southern Taiwan, in which the learning activities were conducted for observing black-faced spoonbills, fiddler crabs, and mangroves (Hung, Lin, & Hwang, 2010). The learning activities were designed as an extension of the formal curriculum of elementary school natural science courses to seamlessly integrate the learning experiences across various dimensions including formal and informal learning contexts, individual and social learning, and physical world and cyberspace indicated by Wong and Looi (2011).

A three-stage seamless learning scaffolding process was provided to guide students to conduct extensive self-learning in the field (Hung, Lin, & Hwang, 2010). In the first stage, the students were guided to obtain background knowledge of the learning targets by answering a series of structured questions based on the observations and interactions with the physical world contexts. In the second stage, a set of open-ended questions were provided to guide the students to further observe and compare learning targets in the field. Moreover, they were asked to articulate their findings and propose questions accordingly. In the third stage, the students were encouraged to perform self-initiated learning by carrying out extended scientific explorations outdoors. It took four months for the students to experience the three-stage field trips. In each stage, the students were guided to observe, explore and collect data in the field one day per week. After each field trip, the students went back to the classroom and wrote digital learning diaries based on the progress and reflections on what they had observed and learned in the field.


Figure 1. Mobile learning activities conducted in Chiku ecological conservation area.

During the field trips, each student was equipped with a mobile device, a telescope, and a digital camera for accessing the supplementary materials, taking notes, observing the learning targets and collecting data. Moreover, they were encouraged to raise questions and discuss with peers. The collected data were uploaded to a workstation for analyzing the ecology of the area. A scale was proposed to assess students' inquiry performance based on the amount, accuracy, and quality of the observation records and questions raised during the mobile learning process. From the experimental results, the students were categorized into different mastery levels as follows: the basic level students who took few records with rough descriptions, the master level students who took many records with average quality, and the advanced level students who took many records with high quality and detailed descriptions. Based on the findings, some differentiated remedial instructions and learning activities were provided for individual students. It was found that the approach was more effective than traditional in-field learning activities in improving students’ learning achievement, motivation and attitudes (Hwang, Wu, & Ke, 2011).

4.2 The Personal Inquiry (PI) project in the United Kingdom

The Personal Inquiry (PI) project, a collaboration between The Open University and the University of Nottingham, helped young people aged 11-14 to understand themselves and their world through a scientific process of active inquiry. It addressed the need for young people to understand scientific methods and discourses by acting as scientists, carrying out personally meaningful scientific investigations. A computer toolkit, named nQuire, was designed to enable ‘scripted inquiry’ learning, where scripts are dynamic software guides, implemented on personal devices such as netbooks and smartphones that support a continuity of learning between formal and informal settings. In a typical investigation, young learners started in the classroom, investigating a topic online, developing shared inquiry questions and proposing methods of investigation, supported by the teacher. They used the nQuire software to plan what types of data to collect, ranging from social surveys to data probes, and how to organise the results. Then, at home, in the playground or outdoors, they collected the data individually or in small groups, with the software providing data checking and visualizations. Back in the classroom they shared and compared results, producing group presentations that addressed the inquiry questions. Here, management of the learning passed from the software back to the teacher, who could view the individual and group results, and assisted the pupils in interpreting the findings and reflecting on the inquiry process. This seamless transition between learning within and outside the classroom was assisted by a shared representation of the inquiry process (Figure 2). It functioned as a classroom aid (one teacher displayed a version as a large poster on the wall of the science classroom), a Home Page for the nQuire application, and a list of menu items on the main nQuire screen to select phases of the current inquiry. An authoring component of nQuire enabled a teacher or educational designer to select, author and modify the scripts and to monitor and guide the student activity.

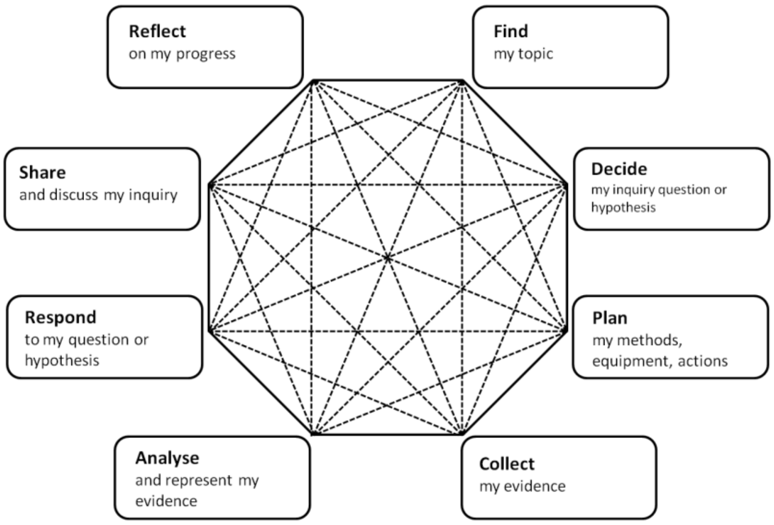

Figure 2. Shared representation of the inquiry process (from Anastopoulou et al. 2012).

Six school-based trials were conducted to evaluate this combination of technology and pedagogy on topics of: urban heat islands (twice), heart rate and fitness, microclimates, healthy eating, sustainability, and effect of noise pollution on birds. Results that compared outcomes with those of a control class, showed a positive effect on learning outcomes and a maintained enjoyment of science lessons. Interviews with participants across the trials provided evidence of increased understanding of the inquiry learning process by children and teachers alike (Anastopoulou et al., 2012).

4.3 The Geometry Mobile (GEM) project in Sweden

Geometry Mobile (GEM) is an on-going mobile learning project in the field of mathematics trying to find alternative ways to support the learning of geometry using mobile and positioning technologies (Sollervall et al., 2011). The project brings together a group of researchers from Linnaeus University in the fields of media technology and mathematics education working very close with teachers and schools. The activities involved in this project are related to inquiry-based geometric learning tasks involving transitions between different contexts including outdoors and classroom tasks. The focus is not only on the appropriation of technologies used within a specific learning context but also on how the appropriated technologies support these transitions, in particular how they enabled effective communication of mathematical strategies. Our motivation has been to design learning activities that stimulated students' enactive modes of action by putting special focus on spatial orientation while minimizing features related to spatial visualization.

Guided by design-based research and the notion of seamless learning, we have designed and implemented a series of learning activities in mathematics where mobile and web technologies support transitions between outdoor and indoor learning contexts (Nilsson, et al., 2010; Sollervall et al., 2011). The students' initiatives during the self-regulated outdoor part of the activity are scaffolded by the use of mobile technologies and activity prompts which provide means and demands for data collection, measurements, on-the-spot oral and visual recordings of the groups' experiences and strategies. These efforts are carried out as a sequence of activities distributed across different contexts, according to the following:

- Introduction and instrumentation
- Self-regulated outdoor activity
- Presentation and discussion of results in the classroom
- Problem-solving using interactive visualizations (Web Visualizations and Augmented Reality)

These activities draw on the use of GPS technology available in a mobile device. The research team has developed a set of mobile applications that allow students to measure distances between their own devices and mobile devices held by other students, as well as to collect data and record audio annotations. The data collected by these mobile applications is stored in a central repository for using later in the classroom. A web-based geo-visualization tool and an augmented reality application are used back in the classroom to visualize and reflect upon the activities conducted in the field.

Since 2010, we have been running these activities with five classes from four different elementary schools in our region. By participating in the activity, the students are offered opportunities to experience geometrical constructions in full-sized space. Specifically, they are stimulated to make use of their orientation ability, which differs cognitively from the visualization ability which is more commonly used to solve similar tasks in school. These kind of learning activities offer the participating students enacted experiences of school geometry which are not commonly offered in school contexts (Sollervall et al., 2012).

The outdoor explorations, the use of mobile technologies, and the distribution of the activity across time and locations, pose didactical as well as technological challenges which call for careful considerations regarding the design of the activity (Sollervall et al., 2012). The different learning tasks being distributed across time and locations make them fulfill two of the ten dimensions (MSL3 and MSL4) characterizing mobile-assisted seamless learning, as described in section II. We will further discuss the dimensions of MSL in relation to these activities in further detail in the last section.

4.4 Sustainable Seamless Learning in a Singapore primary school

Code-named "SEAMLESS Project", our longitudinal study of school-based research with a primary school in Singapore is now into its fifth year. In this project, we explore, apply and refine the notion of seamless learning to design as well as study the integrated and synergistic effects of learning in both formal and informal settings (Looi et al., 2010). Learning is distributed across different learning processes (emergent or planned) as well as across different spaces (in or out of class), as shown in Figure 3. Type I refers to planned learning in classrooms while Type II means planned learning outside of school environments like field trips. Type III refers to emergent learning happening outside of school, mostly driven by learners' interests and initiatives. Finally, Type IV means emergent learning in class, such as unplanned teachable moments and serendipitous learning (Chen et al., 2010). Mobile devices are as mediating tools to facilitate the seamless integration of these different types of learning spaces.

We revised and *mobilized* two years' worth of the national curriculum for Primary 3 and 4 Science which seeks to extend learning activities beyond the classroom from Type I to II, III and IV (Zhang et al, 2010). To support the long-term learning activities, 34 students from the experimental class were each assigned a smartphone with 24x7 access in order to mediate a variety of learning activities such as in-class small-group activities, field trips, data collection and geo-tagging in the neighborhood, home-based experiments involving parents, online information search and peer discussions, and digital student artifact creation, among others. We did an ethnographic study of six students to explore the linkages of their learning and lived-in practices across these types of learning. Learning experiences are deepened when a virtuous cycle is created, where the students can establish continuity of experiences connecting both the formal and informal learning spaces (Chen et al., 2010).

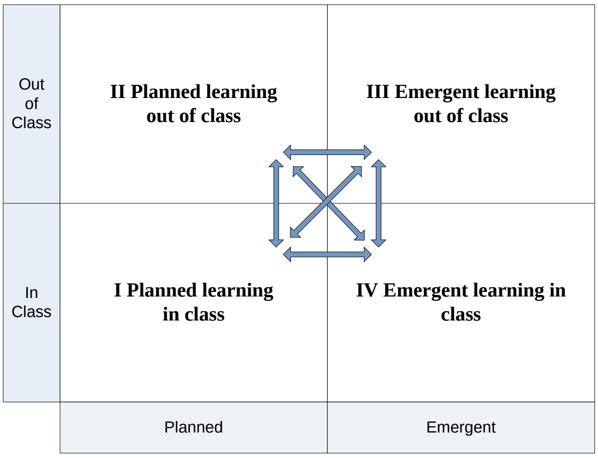

Figure 3. Matrix of learning spaces (adapted from: So, Kim and Looi, 2008)

A separate thread of research which stems from this seamless learning research and which has grown into a distinct research programme of its own is the design of seamless learning for Chinese language learning. The "Move, Idioms!" (Wong, Chin, Tan & Liu, 2010) and the MyCLOUD (Wong, Chin, Jan & Chai, 2011) projects seek to leverage mobile technologies to mediate and support assimilation of language learning into the learners' daily life, followed by deep learning through personalized and social meaning making in the online learning space.

4.5 Learning by logging project in Japan

Our current research focuses on how to capture learning experiences in our daily life, then share and reuse them for future learning. We have developed a ubiquitous learning log system called SCROLL (System for Capturing and Reminding of Learning Log) (Ogata et al., 2010). A Ubiquitous Learning Log (ULL) is defined as a digital record of what the learner has learned in his/her daily life using ubiquitous technologies. It allows the logging of his or her learning experiences with photos, audios, videos, location, QR-code, RFID tags, and sensor data, and to share and to reuse ULL with others. Using SCROLL, learners can receive personalized quizzes and answers for their specific questions. Also, they can navigate and be aware of their past ULLs supported by an augmented reality view. SCROLL supports learning in formal and informal contexts, both individual and collaborative, in the physical world and cyberspace, using multiple devices such as desktop computers and Android tablet PC and smartphones, and for multi-disciplinary domains (Wong and Looi, 2011). Figure 4 below illustrates the learning processes in the "learning by logging" model, called LORE (Log-Organize-Recall-Evaluate), and the system components, called 4R model (Record-Regulate-Remind-Refine) (Ogata et al., 2011)

(1) Log what the learner has learned: when the learner faces a problem in the daily life, s/he may learn some knowledge by him/herself, or ask others for a help in terms of questions. The system records what s/he learned during this process as a ULL Object (ULLO).
(2) Organize the ULL: when the learner tries to add a ULLO, the system compares it with other ULLOs, categorizes it and shows if similar ULLOs exist. By matching similar objects, the knowledge structure can be regulated and organized.
(3) Recall the ULL: the learner may forget what s/he has learned before. Rehearsal and practice can help the learner to recall past ULLOs and to shift them from short-term memory to long-term one. Therefore, the system assigns some quizzes and reminds the learner of past ULLOs.
(4) Evaluate: it is important to recognize what and how a learner has learned by analyzing the past ULL, so that the learner can improve what and how to learn in the future. Therefore, the system refines and adapts the organization of the ULLOs based on the learners' evaluation and reflection.

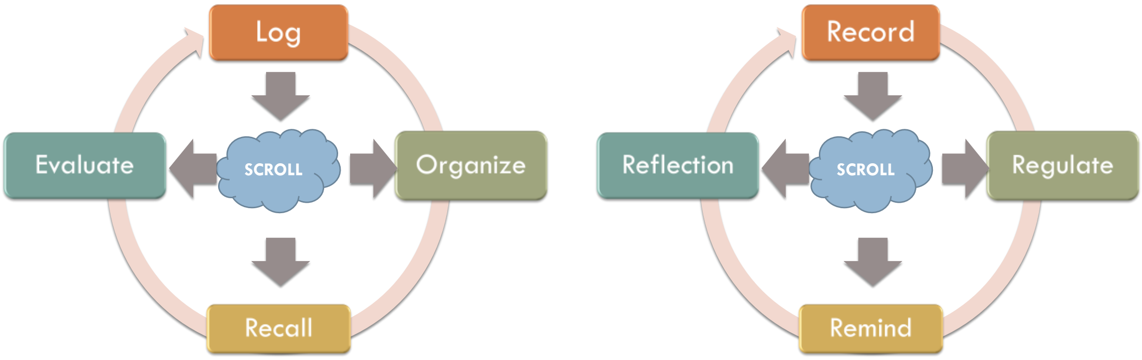

Figure 4: LORE (left) and 4R model (right) for learning by logging.

Based on the above models, a Web and an Android OS version of the SCROLL system have been developed. An initial experiment has been conducted in an English course at University level in order to entwine vocabularies learned in-class and out-class by using the system.

5. Discussion and Conclusions

The five seamless learning projects presented in this chapter exemplify diversified possibilities for designing for, facilitating and practicing such a learning approach. The learning design applied in all five projects not only involves cross-time (MSL3), cross-locational (MSL4) activities, but also encompasses formal and informal learning settings (MSL1), personalized and social learning (MSL2), and physical and digital worlds (MSL6). However, if MSL1, MSL2 and MSL6 are conceptualized as three continua, then the five learning designs are in fact exhibiting varied emphases between the three respective pairs of poles. The different learning activities were designed for and implemented in formal and informal educational contexts; and we argue that they contain several features with strong impact for broadening students´ learning experiences beyond both, the activities themselves and also beyond the learning context in which they take place. In a formal school context, the flow of learning is controlled and supported by the teacher, while the learner herself becomes primarily responsible for her learning in informal contexts. As noted by Wong and Looi (2011), the "learners need to be engaged in an enculturation process to transform their existing epistemological beliefs, attitudes and methods of learning".

An analysis on the five reported learning designs with respect to the 10 MSL dimensions introduced in section II may result in the GEM and the SCROLL project being placed at two different ends of a spectrum, while the other three projects are situated somewhere in the middle. The GEM project is more formal learning- and social learning-oriented (MSL1 & MSL2), as the entire learning process is facilitated by the teacher and takes place at designated time and locations, with a group of learners learning together, face-to-face. The “Learning by logging” activities in the SCROLL project are largely (individual) learner-driven and occur at formal and informal learning settings. In other words, the SCROLL system is intended to support highly personalized learning while social learning is achieved in an indirect manner (i.e., reusing other learners’ ULL). What is similar in both projects is the MSL6 dimension – both are employing augmented reality (certainly a technology that bridges the physical and digital worlds) in their technological solutions that serve as the *enablers* of the respective learning activities (without the technology, such activities could not be carried out at all).

In between, the learning process designs in the inquiry-based seamless learning project in Taiwan, the PI project in the United Kingdom and the SEAMLESS project in Singapore exhibit a similar learning flow pattern characterized by: (1) Teacher-facilitated classroom activities; (2) out-of-class individual or small group activities; (3) online or in-class data sharing or peer learning and (4) in-class consolidation activities. The three projects attempt to strike a balance between learning in formal and informal, and personalized and social settings. The SEAMLESS projects places a greater emphasis on leveraging 1:1, 24x7 access to the mobile devices for learner-initiated, personalized data collection in their own free time. The Taiwanese project focuses on teacher-facilitated fieldtrips as the only means of data collection. The PI project ran a series of studies that connected classrooms with a range of formal and informal settings for data collection including home, playground, fitness centre, discovery centre, and city street. In terms of MSL6, the three projects do encompass learning in physical and digital worlds. However, the digital technologies employed by these projects (with the affordances of data capturing and processing, student artifact creations, online discussions, etc.) serve as the *enhancers* of the learning activities and the physical and digital-based learning aspects of the activities are not as tightly coupled as in GEM and SCROLL. That is, such seamless learning processes could still be carried out without digital technologies. However, it is the technologies that vastly enhance the learners' learning experience and learning effectiveness across multiple spaces.

In essence, the similarities and variations across the five learning designs as we have analyzed above are perhaps the result of the diversified research goals and the specific nature of the subject matters that have been addressed in these projects. However, the salient seamless learning features, as encapsulated in the 10-dimensional model, are still exhibited by these learning designs. The formal education system all over the world has long been dominated by the instructionist and transmissionist views of learning, which carries the notion that knowledge can be decomposed into isolated basic elements and be transferred separately to the learners. Instead, the notion of seamless learning emphasizes 'chain effects' across learning spaces that contribute to build learning progressively across contexts and time, using mobile technologies for augmenting human semantic and episodic memories by capturing and connecting previous learning activities and content, and to adapt the learning to the learner's current physical, social and educational setting. Such a disposition is congruent with Sharples' (2009) assertion that 'it may not be possible to determine when the learning begins and ends.' (p.19).

Goodyear (2011) claims that we are facing two perceptible changes in the field of educational research. The first is a shift in our sense of the spaces and contexts in which education takes place, as different learning activities are becoming more commonly distributed across a variety of contexts. The second change is a wider understanding with regard to the conception of educational praxis, acknowledging the growing importance of design. Addressing these two challenges calls for new integrated design approaches for technology enhanced learning. One of the major challenges of today's education is no longer about finding the best ways for knowledge delivery, but rather designing, developing and implementing interactive learning experiences and activities for learners to construct knowledge by engaging and inspiring them to learn. We believe that the notions and concrete examples presented in this chapter represent a step forward towards achieving such goals. Seamless learning activities of the type illustrated in this chapter, that are highly self-regulated and involve collaboration and communication with peers, can contribute to preparing students for a future which requires them to take initiatives, be creative, take informed decisions, and puts high demand on their social skills.

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