



# Mobile Learning Shareable Content Object Reference Model (m-SCORM) Limitations and Challenges [N09-35]

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## Contents

	<b>Abstract</b>	3
<b>1</b>	<b>Introduction</b>	4
<b>2</b>	<b>Identifying mobile learning</b>	5
<b>2.1</b>	<b>The need for a definition</b>	5
<b>2.2</b>	<b>Background and context</b>	5
<b>2.3</b>	<b>Defining ‘mobile’</b>	7
<b>3</b>	<b>Teaching and learning on mobile</b>	8
<b>3.1</b>	<b>VLE-based learning</b>	8
<b>3.2</b>	<b>Content delivery</b>	9
<b>3.3</b>	<b>Record of achievement</b>	10
<b>3.4</b>	<b>Just-in-time training (performance support)</b>	11
<b>3.5</b>	<b>Social learning</b>	12
<b>3.6</b>	<b>Enhanced reality</b>	13
<b>3.7</b>	<b>Learning support</b>	14
<b>3.8</b>	<b>Experience-based learning</b>	15
<b>3.9</b>	<b>Game-based learning</b>	16
<b>4</b>	<b>Contextualising matrix</b>	17
<b>5</b>	<b>Recommendations for mSCORM</b>	19
<b>5.1</b>	<b>Metadata</b>	19
<b>5.2</b>	<b>Learning experience</b>	19
<b>5.3</b>	<b>‘Searchability’</b>	20
<b>5.4</b>	<b>Tracking of ‘locational’ data</b>	21
<b>5.5</b>	<b>Technical</b>	21
<b>5.6</b>	<b>SCORM compliance and certification</b>	21
<b>5.7</b>	<b>Recommended further research</b>	22
<b>6</b>	<b>Conclusions</b>	23
<b>7</b>	<b>References</b>	24

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## Abstract

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This paper positions traditional e-learning standards (specifically the SCORM standard) in an increasingly mobile world.

First, definition of mobile learning to distinguish it from traditional e-learning needs to be established. Then a number of different mobile learning projects were reviewed, resulting in a list of teaching or learning methodologies that are currently employed in mobile learning. Each methodology is accompanied by sample project description. Most projects described here are unique and innovative and were created as an ad-hoc solution to a specific need, and not as part of a market-wide approach.

The paper offers a contextualization matrix for the methodologies using a table of learning characteristics to place mobile learning as a productive part of the collection of tools available to designers of learning.

Finally the paper makes a number of recommendations which, if implemented, will increase the relevance of the SCORM standard to m-learning.

# 1 Introduction

According to recent research, mobile platforms have become the globally dominant ICT technology. At the start of 2011 it was estimated that there were 5.3 billion active mobile phone subscriptions across the globe (ITU, 2010). In the light of this it is hardly surprising that there has been an upsurge in interest in mobile (m-) learning. Indeed, at the beginning of 2010, many commentators predicted that this would be the year that m-learning would become mainstream (Johnson 2010, Brown 2010, Quinn 2010).

The largest mobile learning project in the UK used the following definition of mobile learning:

*'The exploitation of ubiquitous handheld technologies, together with wireless and mobile phone networks, to facilitate, support, enhance and extend the reach of teaching and learning.'*

**(MoLeNET, 2010a)**

ADL defines it via the devices themselves, as:

*'the use of handheld computing devices to provide access to learning content and information resources'*

**(ADL, 2010)**

Whereas EDUCAUSE explicitly references the mobility of the learner, with:

*'Mobile learning, or m-learning, can be any educational interaction delivered through mobile technology and accessed at a student's convenience from any location.'*

**(Educause in ADL, 2010)**

Contrary to traditional PC-based e-learning (desk or laptop), a majority of m-learning projects have not involved VLEs or standards-based approaches. For example, Traxler (Ally 2009, 9–24) identifies six categories of emergent m-learning, of which only one ('miniature but portable e-learning') necessarily requires either a VLE or content developed using standards for delivering digital learning resources (e.g. SCORM).

In essence the current state of the m-learning market is similar to that which existed in the e-learning market prior to the establishment (and wide acceptance) of standards: a great variety of solutions that cannot operate with one another,

implemented using different development platforms (some web-based, others completely standalone). In many cases solutions are developed to answer the specific needs of an organization or learning group; while this leads to a very innovative field, some solutions are being re-invented over and over again. The only exception to this are the SCORM players for mobile platforms which extend the reach of the SCORM standard to cover content delivered to mobile devices; but those typically require the content to be extensively re-engineered for the platform.

This report is the product of a partnership between Tribal's Digital Learning Studio (DLS) and Advanced Distributed Learning (ADL) to examine the resulting question: Do existing e-learning standards and approaches readily transfer into the mobile learning domain? In particular, close attention is given to the Shareable Content Object Reference Model (SCORM), including providing recommendations on how SCORM might be adapted in future to better support m-learning.

The research focuses on teaching and learning methodologies as a way of categorizing case studies of different m-learning projects. A large number of these have been drawn together and are summarized in section 3 of this report. Each case study is analyzed in turn to draw together a short list of key approaches to the usage mode of mobile technology in a learning context.

A comparative mapping approach based on Gráinne Conole's work (<http://e4innovation.com/>) has been used in section 4 to relate m-learning teaching approaches to one another based on the way that they relate to a new taxonomy of learning design. This taxonomy is being developed to accommodate all technological developments in teaching and learning. Section 4 illustrates each of the teaching and learning methodologies described in section 3 within this taxonomy as a comparative matrix.

Finally, specific attention is given to the SCORM standard, how it can relate to each presented case, how it might evolve in the future, and what research needs to be carried out to ensure that it moves more effectively onto mobile devices.

## 2 Identifying mobile learning

### 2.1 The need for a definition

Before examining current mobile learning projects and the implication that these have on existing standards, it is important to understand how this document defines mobile learning and how it differs from traditional e-learning. It is important to establish a common definition not only because one has so far been very elusive (Laurillard D. in Pachler, 2007) but also as a point of departure for a discourse around the new pedagogies that mobile learning will give rise to. Just as the statement, 'we're covering this subject using e-learning,' evokes mental images of students sitting next to computers in a class, so should a statement about mobile learning evoke images of learners using mobile technology in a learning context.

The lack of a clear definition is not unique to mobile learning:

*'Controversial and unsystematic terms are the cause of serious problems in examinations of learning situation. Without a consistent vocabulary, it is difficult to relate investigated learning situations to each other and the results are confined to single cases.'*

(Zürcher, 2010)

### 2.2 Background and context

The definition used by MoLeNET is given in section 1. However, a review of the project reveals that technologies such as video cameras (which cannot be currently connected to the wireless or cellular networks) and voting systems (which are typically restricted to a classroom and are therefore not mobile) were also used. These technologies are not consistent with the project's own definition: neither video cameras nor voting systems are ubiquitous (they are only present when the learning activity takes place and then returned to storage) and they are certainly not connected to the wireless or cellular networks. This contradiction between definition and practice strongly suggests that not all of the current mobile learning projects are actually about mobile learning.

The MoLeNET definition of mobile learning refers to two key points: the ubiquitous nature of the technology and the fact that it is a 'connected' device. While connectivity is easy to define—any network connection (either via WiFi or a cellular network) that provides the device access to the World Wide Web—ubiquity is a little trickier.

When discussing traditional e-learning, the mantra of 'anytime anywhere learning' is familiar. However, this is not actually the case: despite the instantaneous nature of today's society, students and employees are still required to go to school, to a library, to arrange a 'study group' and so on—essentially going into 'learning mode.' This defines learning as something unique, outside of our ongoing activities. In the corporate world, getting time for employees to train has always been a challenge (Brooks, 2002), despite requirements of professional development, compliance and ideas such as lifelong learning.



The greatest difference between m-learning and e-learning is that it breaks the 'uniqueness' of learning: individuals no longer need to 'make time' for learning or prepare for it; rather, the knowledge they require is available as needed. This scenario of learning in context and without special preparation means that anything becomes a learning opportunity. Furthermore, learning can now take place within the context in which the new knowledge will later be required, thereby making transfer more effective (Bransford, 2000).

Another major difference has to do with ownership over the technology (which translates to ownership of the learning process):

*‘Ownership of technology helps to promote ownership over learning. It is important that learners either own the technology or at least treat it as if they own it. This means the ability to use it any time they wish, to be free to customise or upgrade it, or even to use it subversively.’*

**(Naismith & Corlett, 2006)**

This is of particular importance to young learners who are in the process of asserting themselves: a majority of the mobile learning projects that were involved in the MoLeNET project indicated that mobile learning led to a greater ownership of the learning process by students (MoLeNET, 2010b). This is in part because:

*‘... mobile machines become personally intimate; they are held close to the body—in a purse, on the lap, in a pocket, on the floor next to the user.’*

**(Alexander, 2004)**

But mobile learning is not just about self-directed learning by the individual; these tools also can be brought back into a traditional, structured learning setting (like a lesson-based activity), and used to enhance, and add value to ‘learning mode’ scenarios too. By connecting the two modes, mobile learning devices open up possibilities for new pedagogies, weaving exploration, discovery and questioning into everyday life.

Consider a technician confronted with equipment he has never seen before: instead of heading back to the office to try to find the relevant documentation, he uses his phone to carry out a visual search (using applications such as Google goggles, Thrum). This retrieves the relevant documentation for the item and, by scanning the device’s serial number barcode, the technician is also able to access the item’s history. In this manner the technician is able to resolve a problem he is facing immediately, whereas traditionally, a course or ad-hoc training session would have been needed.

While this type of activity is a departure from the traditional, linear learning formats of e-learning,

their immediate, contextualized nature means that the impact they have on the learner’s behavior or performance is potentially much greater.

This example can be used as a marker against which devices can be tested when their relevance to mobile learning is questioned: Could this scenario work with a laptop? Not without extensive preparation. Nor would tablets (such as the iPad) since such a device would need to be specifically carried along for this purpose. In this context ubiquity becomes synonymous with ‘pocketable.’

The ubiquity of the device goes a long way to encourage things such as on-the-fly learning (which improves access to learning) and ownership of the learning context and process (which improves motivation and interest). For the first time, educators and trainers have the ability to embed learning into everyday life, legitimizing the application of structured questioning to any and all experiences. As a way of life this is not new and seems like a return to a more natural way of learning for us:

*‘Three hundred years ago we were all mobile learners—we learnt in the spaces where the skills needed to be practised.’*

**(Short, 2009)**

Having discussed the elements of mobile learning, we can now establish a more accurate definition. The definition used by the eLearning Guild states:

*‘Any activity that allows individuals to be more productive when consuming, interacting with, or creating information, mediated through a compact digital portable device that the individual carries on a regular basis, has reliable connectivity, and fits in a pocket or purse.’*

**(eLearning Guild, 2008)**

Training designers can only focus on the important task of weaving mobile learning into the fabric of formal learning once they agree on what mobile learning is. This definition provides us with a method of identifying mobile learning and, while there are bound to be initiatives which are on the fringe of ‘pure’ mobile learning (such as the use of iPads as the technology of choice (Gliksman, 2010)), it minimizes the confusion as to the essence of m-learning.

## 2.3 Defining ‘mobile’

Looking at current literature about mobile learning reveals the need for a definition of what constitutes a mobile learning enabler. In a recent report, all of the following are considered to be mobile learning devices:

- smartphones (inc iPhone)
- netbooks
- PDAs
- Nintendo DS
- SONY PSP
- media players
- iPod Touch
- voting systems
- specialist handhelds
- cameras and headcams.

Some of these are clearly relevant: smartphones, PDAs, the iPod Touch and some media players fit perfectly into the definition provided earlier. But others do not. For example, devices that need to be carried specifically for learning purposes (like netbooks) or require special preparation

(like cameras) break the concept of learning as a spontaneous everyday activity.

An extreme example of this, as mentioned before, are voting systems, which typically are only used in the classroom. However, other devices that would not typically be with the learner daily include cameras, video cameras or netbooks. (it is not clear why netbooks are considered mobile learning devices while laptops are excluded.) For a device to be a true mobile learning enabler it needs to be not only ‘hand-held,’ but also ‘hand-operated.’ Furthermore, devices like cameras or voting systems do not take part in the actual cognitive process of learning—they are tools with which content or information is collected to be used later in the process. While these devices are extremely useful for learning, they cannot not considered to be mobile learning devices according to the eLearning Guild’s definition.

Table 1 below maps the devices listed above against the issues described previously in the context of mobile learning.

Table 1: Device types mapped against definition of mobile learning

Device type	Ubiquitous and intimate	Requires preparation	Connected
Smartphones (inc iPhone)	Yes	No	Yes
UMPCs/Mininote/netbooks	No	Yes	Yes
PDAs	Yes	No	Yes
Nintendo DS	Yes	No	No
SONY PSP	Yes	No	Yes
MP3/MP4/media players	Yes	No	No
iPod Touch	Yes	No	Yes
Voting systems	No	Yes	No
Specialist handhelds	No	Yes	Yes
Camera and headcams	No	Yes	No

Two points are important to note in this discussion. The first relates to the rigidity of the definition of mobile learning devices—this should be seen as a spectrum rather than a ‘yes/no’ definition, so some devices might be closer to the pure definition than others. The second point has to do with the ways in which the devices are used in: students writing a book report on the iPod Touch are not engaged in mobile learning but rather using a tool; students on a field trip taking notes and pictures of plants that will later be incorporated into a report are engaged in mobile learning since they are more productive as a result of using the mobile device.

### 3 Teaching and learning on mobile

In preparing this report we have reviewed a large number of m-learning examples, which has revealed a number of different approaches. These are described below, along with case studies and a connection to mSCORM where applicable.

It is important to note that some projects employ a collection of m-learning tools; this modular approach means that some projects are relevant to multiple categories. Also, because of the less structured nature of mobile learning, some of the more advanced projects still arise within the education sector. As result, most of the sample projects given in this section come from the education sector. However, they are primarily intended to clarify the methodologies to which they relate rather the context in which they exist, and where possible examples have been taken from either vocational or in-work learning scenarios.

#### 3.1 VLE-based learning

Virtual learning environments (VLEs), such as Moodle, BlackBoard (WebCT), SABA and others, have been around for a while. They utilize the PC and network to centralize everything that has a bearing on an individual's learning. This includes learning schedules, learning activities, reading materials, interactions (forums), linear content and more. In traditional e-learning (and specifically in the workplace) these are the most prolific technology. Most of the following categories are included within the mobile VLE in some way (typically as modules).

Several technology providers are in the process making their products available on mobile devices. There are two key trends here. The first is the development of apps (such as the Blackboard app shown in fig. 1): these are installed on the mobile and allow device-specific features to be utilized. They can also use content caching to mitigate connection issues when the learner is not on campus.

The second trend is web-based VLE access: these essentially make a mini-website suitable for the mobile device. The key advantage here is that even devices that cannot be extended using apps have a browser. Fig. 2 shows a screen shot of the MLE project, which aims at mobilizing Moodle. (Other projects are currently at different stages of

completion.)

Fig. 1: Blackboard VLE interface on Android.

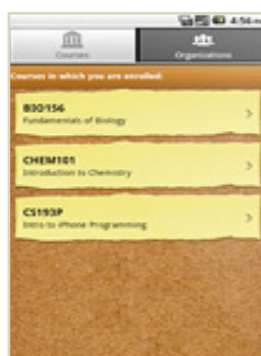
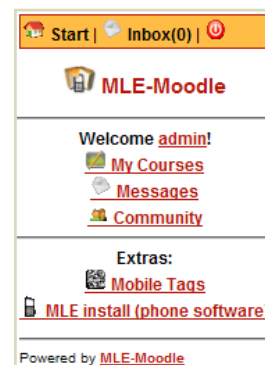


Fig. 2: MLE mini website.



#### mSCORM application

Assets within a VLE will typically already be tagged in a SCORM-friendly manner. Adding a second version of each asset (for example a smaller video or image) suitable for use on mobile devices (for example, at a lower resolution) could be of immense value.

#### Sample project

When training teaching assistants on a foundation degree in Educational Studies, Leicester College was confronted by two issues:

- The course was mostly work-based (apart from a weekly meeting), and students found it hard to record classroom activities into their VLE (Moodle) because it is impractical to opening a laptop in a chaotic primary school classroom
- Learning did not take place in a specific location. This prevented the students from presenting a coherent reflection on their learning (in some cases paper notes were used, in others memory was relied on etc.).

The WoLF (Work-based Learners in Further Education) project looked at using pocket PCs as a solution to need to access the college VLE and as a way to integrate the dispersed learning activities. The mobile devices were synchronized with the VLE and offered the students wikis, forums, blogs and other learning objects. Work was carried out to ensure that the existing content was usable on the small screens. The devices allowed students to take different types of notes while in class and to access resources via the web.

The use of mobile devices has altered the nature of the course: students' reflection has become coherent to such a degree that they are now using an online journal to reflect on the learning on a regular basis. This has also had an impact on the feedback and guidance that students receive from their tutors since the evidence that is collected in class (video, audio and still images) is readily available to the tutor.

The project, which began in September of 2007, relied on sideloading (students used home PCs to synchronize the mobile devices) of HP pocket PCs. While in the past the devices were provided to the learners by the college, it is expected that as personal technology catches up more and more students will rely on their personal devices.

More information can be found at:

- [www.jisc.ac.uk/whatwedo/programmes/e-learningcapital/heinfe/wolf.aspx](http://www.jisc.ac.uk/whatwedo/programmes/e-learningcapital/heinfe/wolf.aspx)
- [www.blackboard.com/Mobile/Overview.aspx](http://www.blackboard.com/Mobile/Overview.aspx)
- [www.mobilemoodle.org](http://www.mobilemoodle.org)

### 3.2 Content delivery

Under this category we include both podcasting (one of the earliest trends in mobile learning) and full SCORM package delivery. Although the method of creation of these two types of content delivery is hugely different, as far as the user is concerned the process followed is similar: packages are selected from a catalogue, loaded on the device (or streamed) and consumed while doing something else (e.g. commuting, waiting for the dentist). Developers of this type of content have internalized the need for much shorter delivery times.

One of the main challenges when consuming content on the go using a mobile device is that the 'casting' type material is not tracked so authors cannot see if there are typical pause points—or even if users complete the viewing after downloading the material.

The key difference between this category and most others is that the learner makes a conscious decision to consume content and is cognitively focused on this task: the learner has an estimate of how much time is available (for example two stations before I hop off the commuter train) and is geared to invest that time in further his knowledge.

#### mSCORM application

This is where the SCORM standard needs the smallest modification to add value: traditional SCORM packages can be used as is. The standard would also benefit from the suggestion made in section 5. With regards to delivery of content assets (video or audio for example), any modern LCMS system should make these available independently (if tagged correctly) to different users. But this is more a comment about the capabilities of LCMS systems and proper metadata tagging of assets than about the relevance of the SCORM standard itself.

A very useful review of mobile SCORM players is included in Jason Haag's presentation on 'SCORM Implementation Strategies for Mobile', available at <http://slidesha.re/hXMidx>.

#### Sample project

One of the most publicized mobile SCORM projects started as part of Merrill Lynch (now Bank of America): the firm wanted to deliver training to all of its 21,000 BlackBerry users. The key objective was to increase the completion rate of learning material by using three characteristics of mobile learning: ability to learn outside the office (while commuting); breaking mammoth content packages into smaller chunks (therefore making them easier to complete); and leveraging existing usage patterns of the devices—accessing information for more than 30 minutes a day while on the go.

A pilot was launched in 2006. Content was repackaged for the small screen, and for a period of two months, three compliance courses could be taken via the mobile. These were tracked using the company's LMS via an on-device player application. The pilot produced the following results:

- There was an increase in the average score when compared to the control group (1.21% higher).
- A higher percentage of users completed the courses (12% higher after 45 days).
- Users took less time to complete the courses (45% less on average, some completed in 80% less time).

When collecting feedback from the learners, the results were even more encouraging: 100% of the learners reported that they would be happy

to complete more training in the mobile format, and 99% of the learners thought that the format supported the learning objectives.

Following the pilot, Merrill Lynch made the mobile learning solution available to more employees (as content became available).

More information can be found at:

- [clomedia.com/articles/view/2135/7](http://clomedia.com/articles/view/2135/7)
- [www.apple.com/education/itunes-u/whats-on.html](http://www.apple.com/education/itunes-u/whats-on.html).

### 3.3 Record of achievement

Traditional and online assessment have been changing significantly over the last few years: a move from tracking what an individual knows to what an individual is capable of (skills and competencies) is accompanied by a shift from traditional summative assessment ('prove you remember the theory') to formative, record based assessment ('this is what I can do'). As part of this shift, individuals gradually build a record of achievement containing evidence of what they have achieved professionally and what they are capable of. The evidence can take a number of forms, the most common of which are formal accreditation (certificates) and visual records (stills, videos).

In the corporate world, 'talent management' and 'e-portfolio' systems manage not only an employee's learning but also their skills and competences, and they are quickly becoming centre-pieces of the corporate HR department. Driven forward by the need for flexibility (enhanced by the tough economic times) these systems empower managers to identify and deploy individuals with the exact skills and competences needed to solve specific problems or fulfill specific roles.

By tracking skills and competences, organizations can base recruitment on individuals' actual abilities rather than theoretical knowledge. This empowers lifelong learners: they can set their aims on professional advancement and then acquire the skills needed in whatever way they see fit. Being able to complete a task is far more useful to an employer than having accreditation.

In this context, mobile devices can act as a quick way to record and demonstrate achievement. The key advantage to using mobile devices in this manner is that an achievement is not always pre-planned or recordable in any other way. In addition to the sample project presented below—where mobiles are used to record evidence of achievement in the field of sports studies—mobile phones have also been used to record apprentice builders' ability to complete tasks (such as building a wall).

The situation in the e-portfolio market is similar to that for VLEs: several e-portfolio providers have made their system accessible via mobile devices.

#### mSCORM application

Mapping SCORM packages to skills and competences 'makes sense,' but rarely happens today. A further emphasis should be put by the standard to encourage flexible flow: by mapping which SCOs can interlink to impart a coherent skill, the value of each SCO will be enhanced (since it becomes relevant to more learners taking different paths). By creating a facility for on-the-file re-sequencing of SCOs (either within a single package or across multiple ones) the standard will allow the learner to grow outside of it (by taking a course from a different institution) but always keep the record-making management of competences ever more powerful.

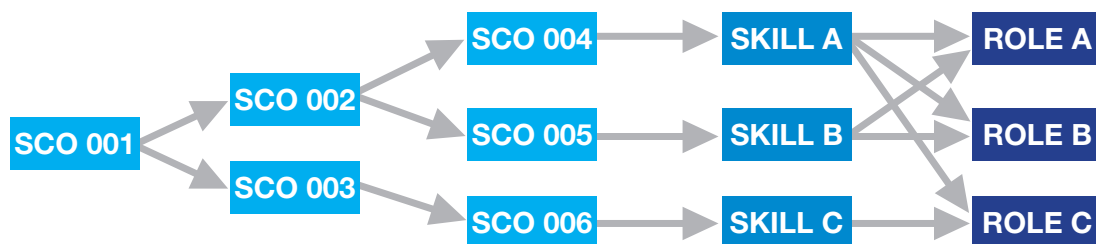


Fig. 3: A skills map showing how different paths can provide the individual with different skills that merge into organisational roles.

Further discussion of this can be found in section 5 as part of the recommendations for the mSCORM standard.

### Sample project

Students at South Nottingham College were required to produce evidence as part of their learning process in the NVQ in Activity Leadership and Coaching, Teaching, Instructing Football. As these activities are typically physical by nature, creating evidence in a traditional, paper-based way quickly became an issue.

In an attempt to find a simple solution, the college decided to look at the digital option: mobile phones were chosen, because a relatively large proportion of the students have them and are comfortable using them. Once the validity of digital evidence was verified with the external verifier, students started collecting evidence (video clips, images and audio clips, etc.) using their own devices. Those students who did not own a device were able to borrow a video camera from the college.

As the students became accustomed to using the mobile devices as part of the learning experience, more features were put into use (such as internal stopwatch function). The new method for evidence collection not only reduced paperwork and saved time but also increased both the reliability of the account (since the evidence reflects the activity more accurately than a written report would) and the students' motivation.

The college has subsequently decided to invest in a number of mobile devices (rather than video cameras) that can be loaned to students. The college is also evaluating e-portfolio packages to provide the students with an evidence focused infrastructure.

More information can be found at:

- [www.excellencegateway.org.uk/page.aspx?o=165762](http://www.excellencegateway.org.uk/page.aspx?o=165762)
- [www.eportfolios.ac.uk/mobile](http://www.eportfolios.ac.uk/mobile).

## 3.4 Just-in-time training (performance support)

Focusing on the 'task at hand' or 'the moment of need,' just-in-time (JIT) training (or 'performance support,' as it is more commonly known) deals with an individual's need for an answer to an immediate problem. When sitting next to a PC the solution is usually found through the Internet or the corporate intranet using search tools. Mobile devices, however, can be used literally anywhere and as such can be used when the user is looking for a solution to a virtually limitless array of problems.

The advantages of performance support include the ability to track the user's knowledge gaps: if a user of a system needs to consult a training package on his phone over and over again there might be a problem with the system design. It is also crucial to legitimize asking questions—the intimate nature of the mobile device (discussed in the definition section) means that users are more likely to ask questions relating to common issues they face (no matter how trivial).

### mSCORM application

It is probable that the last thing an individual would like to do when facing an immediate problem is go through a 15-minute session (or longer) to find an answer that seemed trivial to the instructional designer who designed the package. As discussed in section 5, adding an ability to search within SCOs and then jump to a specific screen or point would greatly enhance the value of these content packages. It would also bring mSCORM to be on a par with what has become the day-to-day learning and information source: the search engine.

As mentioned before, the ability to track repeating knowledge gaps is highly valuable. Adding 'random access' will ensure that the user goes through the path of least resistance (since the package has probably been pre-cached on the device).

### Sample project

A key point in the power of mobile learning is that in many cases learners do not use the technology in the way that the designer of the learning (or the project) envisioned.

A very well known mobile learning project in the UK is a result of collaboration between Stockport College, Trafford College and MIMAS (The University of Manchester). The project provides:

*‘exemplary step-by-step guidance videos, self-evaluation tests, worksheets and guides relating to an expanding collection of hairdressing styles and techniques; the service is also mapped to the NVQ Hairdressing curriculum.’ (Hairdressing Training website, 2010). The resources are available in both PC and mobile forms and are available to anyone interested in learning about hairdressing (since September 2010).*

Because the content designers decided not to enforce a rigid structure, a user can jump directly to any section of the content. For example, a hairdresser preparing for a graduated cut can review a step-by-step guide at <http://htmobi.mobi/node/71>.

More information can be found at:

- <http://hairdressing.ac.uk>
- <http://htmobi.mobi>.

**In this Section**

- [The Fundamentals](#)
- [Corrective Haircolour](#)
- [Corrective haircolouring: Step-by-Step Guide](#)
- [Integrate to create](#)
- [Integrate to create: Step-by-Step Guide](#)
- [Multi-dimensional colour](#)
- [Multi-dimensional colour: Step-by-Step Guide](#)
- [The Fundamentals: Step-by-Step Guide](#)

**Lessons**

- [Effectiveness at Work](#)
- [How to Cut Hair](#)
- [Skin and hair](#)
- [Hair travel](#)
- [Hair Colour](#)
- [Setting hair](#)
- [Blow-drying techniques](#)
- [Client and hair analysis](#)
- [Health and Safety](#)
- [Dressing long hair](#)
- [Perming and neutralising](#)

**Main Menu**

- [Home](#)
- [Get Started](#)
- [Male Cuts](#)
- [Female Cuts](#)
- [Lessons](#)
- [Skills & Equipment](#)

Fig. 4: A sample section from the mobile site looking at hair colour, *Hairdressing Training service*

### 3.5 Social learning

Social learning, also known as ‘collaborative learning,’ is one of the strongest current trends in the technology based learning field, as shown by the popularity of such tools as Facebook and Twitter. Its application varies: in some cases there is a social element to existing learning platforms (VLEs being a key example); in others a complete self-contained collaborative platform (e.g. Google groups) is available for learners. Social learning can be either moderated or unmoderated, and can be used in both formal and informal settings.

Mobile devices are particularly applicable to social learning as they effectively act as accelerators of the social discourse. They allow learners to consume and create content, whether through SMS messages (which are unique to phones) or because of their ability to ‘be part of the action’, contextualizing any interaction—as soon as a collaborator has an idea or questions, he or she can share with the rest.

#### mSCORM application

mSOCRM is less applicable to social learning because of the distance between the premise behind SCORM (linear, individual content) and that behind social learning (ad-hoc or continual collaboration between individuals). Collaborators can share recommendations when specific learning content has answers to an individual’s questions, but other than the scope of social learning within mSCORM is limited.

## Sample project

See 'Enhanced reality' below.

### 3.6 Enhanced reality

This category covers two distinct types of experiences for the learner around a common theme—the use of a camera and display to add a layer of digital information over the visible environment:

#### 1. Enhanced reality<sup>1</sup>

In this type, a digital device equipped with a camera uses visual cues (similar to a QR code) to add a 3D image. So far this has been used mostly for marketing or entertainment purposes. This technology allows a user to manipulate a 3D image



Fig. 5: An advertising campaign for the automotive company MINI, where the user holds the ad in front of a webcam and sees an animated 3D MINI 'pop-up' on the page.

of the object by moving the object on which the code is printed.

#### 2. Reality browsers

By using the device's GPS functionality (providing location) together with its built-in compass (providing direction), this piece of software can display to the user information about the environment overlaid on the image captured by the device's camera. This ranges from historical images ('this is what happened here a hundred years ago') to identifying the direction to the nearest public

<sup>1</sup> This term is used simply to differentiate the two augmented reality modes.

transport terminal. In the example shown in fig. 6, the Berlin Wall has been 'returned' to its original location to give the user a feeling for the way in which the wall affected its surroundings.

A number of reality browsers are currently available for different mobile platforms and most have an authoring tool (or guide) for users to develop and then distribute their own content. Some of the content (layers) is available for free.

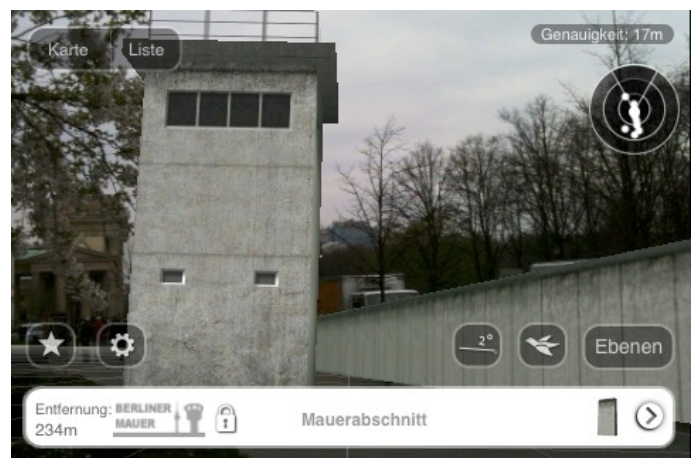


Fig. 6: Screenshot from *The Berlin Wall 3D* layer from the Layer Reality Browser app.

Augmented reality (in both of its forms) provides a wonderful opportunity for learning within the environment, and while 3D object manipulation is probably easier on the laptop (or desktop), reality browser are the sole domain of the mobile device.

#### mSCORM application

The main applicability of mSCORM to location-based enhanced reality would be to tag SCOs (or complete packages) to make them appear in such a context. Providing instructional designers with the ability to specify the location and direction that the learner should be looking while going through a training session could be immensely powerful: imagine a TSA screener learning about the importance of airport security while sitting next to 'ground zero' in Manhattan, or a learner understanding the history of London using the Museum of London app. By introducing an emotional context to the learning (achieved through geo-location) the retention of content could be greatly improved.

A second addition to the standard could cover tracking the learner's geographical path: this would record the GPS sensor output of the device to be used as evidence of completion of the learning task. For example, to demonstrate understanding of historical facts relating to London, an individual would need to reach a specific landmark; in some cases the mere following of the path dictated by the learning package might be enough. A slight twist on this could be applied to enhanced reality—by tracking the way the user manipulates an object (or multiple ones), tasks like alignment or object connections could be achieved.

### Sample project

The 'Expeditie Deventer' (Expedition Deventer) project links a number of methodologies together to appeal to young adults (high school) and help them learn about the city of Deventer and its heritage.

The pilot, commissioned by the city's public library, encourages students to discover the city by splitting them into two groups. The first group roams around the city using augmented reality enabled devices (specifically mobile phones) to discover 3D objects and clues. These are sent to the second group, which stays at the library and researches the found items using the resources available there. The second group then sends the search results to the first group, directing them on the mini-adventure. The whole process is dynamic and takes place in real time, which enhances the immersive quality of the adventure. Each team (comprising both groups) gets points for the number of clues and objects they are able to track down.

The social element of this project (even though it is 'real time' rather than longer term) makes it a good example for mobile-enabled social learning—if the teams do not work together they will not succeed in the task.

The project has won the best online educational application for a heritage institution, but it is still in pilot phase and results are not yet available.

More information can be found at [www.expeditiedeventer.nl](http://www.expeditiedeventer.nl).

### Relevant URLs:

- [www.layar.com](http://www.layar.com)
- [www.wikitude.org](http://www.wikitude.org)
- [www.museumoflondon.org.uk/MuseumOfLondon/Resources/app/you-are-here-app/index.html](http://www.museumoflondon.org.uk/MuseumOfLondon/Resources/app/you-are-here-app/index.html)

## 3.7 Learning support

This category covers any secondary sources of information that can be used during a learning activity, or to enable one, but which are not the target of the learning activity itself. This can include campus maps for students, dictionaries, timetables etc. A learning support module appears in a number of mobile learning systems.

With their ability to act as GPS devices, internet terminals and local storage mobile devices are suited to this task particularly well: they allow the user to have a dictionary always to hand (in some cases even recognizing the spoken word) and to find the way easily to the required building on the campus.

While this type of activity might be trivialized by being peripheral to the learning itself, it is a great testament to the ubiquitous nature of mobile devices.

The key differentiation between learning support and performance support is the fact that in the former, the user is in the previously mentioned 'learning mode', where the mobile device delivers content that supports the act of learning (a dictionary used to give a definition of a word that a student comes across while reading a book in the library) and is therefore secondary to the learning process itself. In the latter, on the other hand, the mobile device is delivering the learning experience, but that experience is secondary to the activity that the user is performing—in this case the learning is coincidental.

### mSCORM application

As this scenario is in essence an ad-hoc type of learning (immediate question—immediate answer) similar to performance support, there is not much room for mSCORM beyond the previously suggested global search which is discussed in greater details in section 5.3.

### Sample project

A powerful example of how mobile devices can enable the learning process while not being part of it is the project which takes place at the RNIB College in Loughborough. The college specializes in providing services for people who are blind, partially sighted and/or have other disabilities. Learners need to cope with written material on a daily basis, and for visually impaired learners this is a particularly challenging task. One of the possible solutions is to scan the text and have it read out to the learner at the point of need; unfortunately full A4-size scanners require a computer to work and are bulky and impractical.

By providing a solution based on their personal mobile device, the college has enabled learners to review text anywhere without requiring a full scanning suite: the mobile phone uses an OCR app that takes a picture of the text and then reads it out to the user. This releases the learner from being tied to the location of the scanning equipment—learning from written material can take place wherever the user is.

Here the mobile phone supports the learning, but it is simply a conduit for the written word and is not directly interacted with within the learning context.

More information can be found at [www.excellencegateway.org.uk/page.aspx?o=262117](http://www.excellencegateway.org.uk/page.aspx?o=262117).

## 3.8 Experience-based learning

The great flexibility of mobile devices means that they can be used anywhere and anytime. Experience-based learning merges that flexibility with the multitude of sensors that the devices have—cameras, microphones, GPS, etc. It is the devices' ubiquitous nature that makes them part (or even the target) of the experience the learner is going through. This is the equivalent of learning how to use software on the PC—by doing. This is also where, if designed properly, there is the greatest potential for knowledge transfer.

A number of activities can be given as examples—a class on a field trip collecting images of different architectural styles; a mechanic using a checklist to follow through on a new procedure for acquiring replacement parts for a defective engine; a learner repeating words in a foreign language into the

device microphone so that he can hear and assess his performance; and so on.

### mSCORM application

Because of the variety of activities that this category encompasses it is hard to pinpoint how mSCORM would relate to *any* of them. In some cases the experience might be guided by SCORM packages (leaving space to collect input from the experience) while in others everything might be done with simple instructions. We encourage instructional designers to use all of the devices' capabilities (where possible and relevant)—this is an excellent opportunity to step beyond the screen.

### Sample project

While some of the projects mentioned under other methodologies could be good examples of experience-based learning, the one that was selected to demonstrate the potential of this type of mobile learning is KeyToNature.

This is an EU research project to develop paper-free identification tools for discovering and understanding biodiversity. As part of the project a client app was created for GPS-enabled phones, which allows users to record images of a specimen along with the location and time of collection. An audio note can also be added. The information is then uploaded to a repository which holds all of the collected evidence. A number of schools take part in the project and in some cases the app is used by students on field trips.

Much of the power of this project in the statistical analysis of the collected samples (Where is a specimen common? When does a flower bloom? etc.); however, for the users who collected the samples the interaction with the biodiversity in the field (and later on comparing the different 'finds') demonstrates how mobile technology could be used as a trigger for other experiences.

For this specific project metadata could be used to tag the collected resources and make them available within SCOs dealing with biodiversity or related content.

More information can be found at [www.keytonature.eu/wiki](http://www.keytonature.eu/wiki).

### 3.9 Game-based learning

Game-based learning (also known as 'edutainment') has been a staple of e-learning since the early days. As hardware improved, games became more complex, up to and including immersive 3D environments.

Today's mobile devices include 3D hardware acceleration on top of (in many cases) a capable CPU. This means that they are capable of running complex visual games. Despite the hardware capabilities, however, the size of the screen and the lack of physical game controller (joysticks, keyboards, pads, etc.) means that games need to be very well adapted to the medium to entice the user to stay more than a few minutes.

Learning games on the mobile device require special attention to the design phase so as to be successful on the small screen.

#### **mSCORM application**

The experience gained from learning games on the PC means that the manner in which they integrates with mSCORM is likely to take a similar step: mSCORM packages will include game-like interactions within them but it is unlikely to see SCORM integrated

#### **Sample project**

The 'Millee' project, which began in 2004, focuses on emerging economies. It provides a useful insight into the potential benefits of employing m-learning in regions suffering from high levels of illiteracy. In such areas, children often face practical or cultural constraints on their schooling.

Mobile devices are prevalent in many of these regions, particularly compared to the availability of PCs (Kumar et al. 2010). It has therefore often been possible for the Millee project to make use of technology that already exists in the targeted areas (although some devices have been provided by manufacturers).

The project provides learners with language learning games modeled around traditional games that are familiar to any local child. The games were designed with local teachers (in every location)

so that they apply directly to the children. This is important since it makes it easy for the children to understand what they need to do without significant amounts of instruction; it also ensures an initial level of enthusiasm as the child is familiar with the game. 'World' languages such as English can be taught through this medium. The project has conducted a number of studies which are reported on its web site.

One such study, reported by Kumar et al. (2010), is particularly important. It has highlighted both the potential benefits and pitfalls of unsupervised m-learning in emerging economies. The key benefit was a measurable improvement in language skills amongst those in the study. However, learning conditions remain in many cases sub-optimal, including technical and cultural barriers to learning in this way.

More information can be found at [www.millee.org](http://www.millee.org).

## 4 Contextualising matrix

The comparative matrix seeks to describe each of the teaching and learning methodologies mentioned in section 3 using an emerging taxonomy of learning design suggested by Gráinne Conole (initially as part of a working group at the UK Open University). This taxonomy was initially developed as part of a system for course representation and was not intended specifically for mobile learning as such; when applied to mobile learning, it should not therefore be used to review complete mobile courses but rather specific learning nuggets (standalone learning ‘pieces’ typically up to ten minutes in execution length).

The main objective behind the presentation of the matrix is to relate mSCORM to learning characteristics supported by mobile learning. In the previous section we suggested an application for mSCORM to every teaching-learning model; here we connect these models to learning characteristics. It is important to note that we refer to the completed mSCORM and not the current application of SCORM in mobile learning.

The secondary objective is to demonstrate what specific types of mobile learning applications can contribute when they are incorporated into an existing blend of learning tools (for both traditional and technology based learning).

Each of the methodologies is mapped according to the following characteristics:

- **Thinking and reflection**—the degree to which the learner reflects on his/her own learning. Practical examples of ‘meta-cognition’-focused tools include blogs and e-portfolios where the learner has an opportunity to discuss the learning.
- **Communication, collaboration and interaction**—the social dimensions of learning (interaction relating to that which takes place between learners and between learners and tutors). Practical examples include forums and e-mail.
- **Information and experience**—traditional content, prior experience and learner-generated content. This includes elements such as e-books, podcasts and multimedia.
- **Evidence and demonstration**—assessment (formative or summative) that is not intrinsic to the learner, but is used by an external element such as a trainer. This can include multiple-choice questions, quizzes, assignments and exams.

- **Guidance and support**—Conole defines this as ‘learning pathway.’ It covers materials that are peripheral to the actual learning but are required for it, such as a map of the campus, the course calendar and structure and study guides. These are typically student-centered and can be either peer supported or tutor led.

In this work Conole seeks to rethink approaches to the design and representation of courses, learning activities and content. Her aim is to specifically accommodate the plethora of technologies that can be used to support learning, offering different ways in which learners can communicate with each other and with their tutors, and providing them with access to interactive, multimedia content. In the context of this report, the key advantage to this work is that it can relate mobile learning to other technology-based learning.

Table 2 on the following page relates the ten teaching and learning methodologies to the characteristics of learning defined as part of Conole’s ‘at a glance’ course representation. While specific activities, which are part of a solution, may differ, what follows is a generic guideline for the characteristics relevant to each methodology:

Table 2

Learning characteristic	Thinking and reflection	Communication, collaboration and interaction	Information and experience	Evidence and demonstration	Guidance and support
<b>Model</b>					
VLE-based learning	+	+	+	+	+
Content delivery	-	+	+	-	+
Record of achievement	+	-	-	+	-
Social learning	-	+	-	-	+
Just-in-time training	-	-	+	-	+
Learning support	+	-	-	-	+
Enhanced reality	-	-	+	+	-
Reality browsers (augmented reality)	-	+	+	+	+
Experience-based learning	-	-	+	-	-
Game-based learning	-	+	+	-	-

Figure 7 is a visual example of the ‘at a glance’ representation that we make use of above—this three-dimensional model is another example (in addition to the table above) of a visual way to represent the types of learning a learner will be engaged with. More information can be found on Conole’s own site: <http://e4innovation.com/?p=328>.

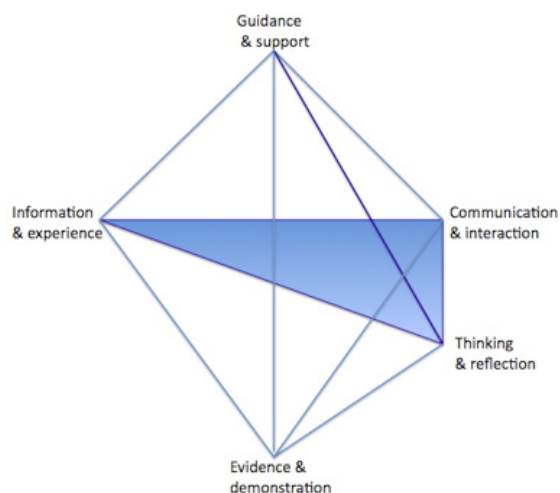


Fig. 7

## 5 Recommendations for mSCORM

When considering modifications that might be made to SCORM in the light of the different approaches to m-learning outlined in this report, it is important to understand that SCORM should never be regarded as a catch-all. Indeed, the authors feel it would be harmful to SCORM's future if it were to become synonymous with m-learning in the same way that it seems, in some circles, to have become the definition of e-learning.

SCORM is, and should remain, a tool that may be applied to solve a finite number of problems in the e- and m-learning domains, specifically those which involve the delivery of trackable, pre-authored content. However, this is not to say that SCORM may not be extended to allow it to embrace developments in digital learning that have occurred since its inception.

Clearly the remit of this paper should confine it to suggestions for extending the SCORM standard that will primarily benefit mobile learning. However, during our analysis it has become apparent that many of the possible additions and modifications will also be beneficial for the use of SCORM in e-learning activities. The ideas presented below should therefore be regarded in the light of both spheres of education.

### 5.1 Metadata

Of all the possible modifications to SCORM, additions to the metadata schema are possibly the most straightforward. These might include:

- 'Locational' information (geotagging) pertaining to the content in the SCO. Increasingly, data standards include geolocation metadata (HTML 5, EXIF / XMP, etc). This is therefore a natural inclusion for use *where relevant* in SCORM packages. A discussion and examples can be found in section 3.6.
- System requirements (technical prerequisites) data: This is particularly relevant in the mobile domain where, unlike in desktop environments, there are significant differences between what different devices support. For example, Flash is not supported on Apple products, content that requires location information can only be used on devices with a GPS, and so on. This metadata could be used to ensure that users do not waste bandwidth downloading SCOs that they cannot use.

### 5.2 Learning experience

SCORM currently supports complex learning paths that may, if codified well, support individualized learning (i.e. the delivery of selected learning objects in an order ideally suited to an individual learner). To enable this, it has always been one of the grounding principles of SCORM that content could (if not should) be created such that a given SCO is both self-contained and small enough to be combined with other SCOs to create an overall learning experience.

However, the tendency of practitioners has been to build entire 'courses' into SCOs. While this approach is fully supported by the SCORM standard, this model prevents the construction of arbitrary learning pathways by combining multiple learning objects. Instead, the entire learning experience becomes rigidly pre-defined by the content creator—a linear experience rather than free-form and tailored to the student.

This use of SCORM has, perhaps, given it a bad name. It has nevertheless been viable in e-learning environments where students are commonly working towards a set of goals specified by an external organization, and will set aside dedicated periods of time for learning.

Things change in content-based m-learning. The possibility to 'learn anywhere' means that learners may often find themselves working on their mobile devices during spare moments while in transit or between engagements. The average time for engaging with a package of learning material is therefore considerably shortened when mobile. Moreover, the opportunity in the mobile domain for 'informal' learning is increased. For SCORM to stay relevant in a world where more learners are accessing information 'on the fly', content packages need to be succinct if they are to be used at all.

With these considerations in mind, the following are some suggested adaptations to SCORM that might enable it to better cater to mobile education:

- Improved bookmarking. Although the SCORM data model currently provides limited bookmarking capability through, for example, `cmi.location` or `cmi.suspend_data`, these are in essence progress markers. A more useful facility would be to enable

users to bookmark in the sense of a web browser's 'favourites' list. With smaller content objects and a more free-form learning process, this useful adaptation would enable users to jump quickly between SCOs of interest to them.

- Enhance the flow between SCOs. Sticking with our assumptions that SCORM in a mobile world requires smaller content objects and must support learner-driven learning, the standard should facilitate navigation between SCOs within a multi-SCO SCORM package. This might take the form of allowing learners to choose which SCO to navigate to next. Alternatively, the learner might be automatically directed to an appropriate content object based on their performance in the activity they have just completed, or the actions they took during it.

The groundwork for this has already been laid in the sequencing and navigation aspects of the standard. Our recommendations in this area are towards allowing open discovery of available SCOs by learners rather than enforcing particular prerequisites for navigation, and allowing the package to dynamically deduce (through performance or actions) sensible possible paths rather than having them pre-defined. We term this latter approach 'dynamic SCO threading.'

- More detailed SCO descriptions. At present, the SCORM standard places few restrictions on what an SCO actually is. It must make use of the SCORM run-time-environment to allow tracking by the host LMS, but aside from this it can be as simple as a single web page or as complex as an entire course. The tendency seems to have been for authors to create larger SCOs, limiting resource reusability and, more generally, pushing learners into linear, pre-ordained learning paths. Additionally, the SCO has tended to become the SCORM package, rather than having repositories containing multiple content objects. As discussed above, this has to some extent damaged SCORM's reputation. If content objects were more rigidly defined in the standard—for example by requiring shorter objects—then this problem might be alleviated. The authors of this paper recognize, however, that any decision about what constitutes an appropriate length or educational approach is highly subjective, and hence difficult to standardize.

**In summary, the authors advocate:**

- a move towards smaller SCOs, encouraging repositories containing multiple content objects

- dynamically generated learning paths, either through allowing open discovery of SCOs by the learner or by dynamic response to learner activity and performance.

In some ways these ideals merely reiterate the goals of SCORM itself. However, observing the way SCORM has actually been used in e-learning, and considering the likely usage of content in m-learning, it may be that these things need to be more rigorously codified in order to make SCORM relevant to the latter domain.

### 5.3 'Searchability'

A key issue adjacent to the learning experience is usage patterns and habits. Users are becoming used to searching for what they need at the click of a button—the universal search included as part of the Android platform is a good example of this trend. Dictating the manner in which mSCORM objects can be made searchable would greatly increase the value of the objects to the learner, specifically in performance support scenarios. In fact learners should be encouraged to search through learning content instead of creating custom performance support nuggets. It is also recommended that a model for jumping into the 'middle' of a SCO is adopted—in that case a user can follow up on a search and instead of viewing the SCO from the start jump directly to the 'page' of interest within the found content.

An important impact of this would be a change in the way that Flash is used: currently searches do not examine the content within a Flash file—this will need to change. However, since Flash only works on the Android platform (currently not the most common smartphone platform) the impact of this is reduced.

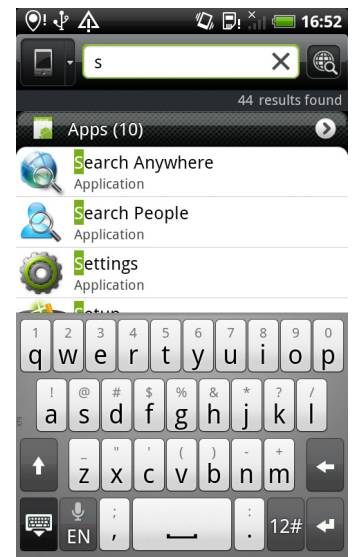


Fig. 8: The search function in HTC Desire Z series

## 5.4 Tracking of 'locational' data

As mentioned in section 3.6 the ability to track the user's physical journey could provide the instructional designer with a powerful tool. A data structure that defines how a GPS record can be created and returned to the server will enable this functionality to come to life. Whether such a record is based on a path that needs to be followed exactly or simply a set of geolocations that can be followed in a flexible order (similar to 'geocaching') should depend on the nature of the learning activity.

## 5.5 Technical

Mobile technology places certain constraints on what types of SCORM content may be supported. We leave aside device-specific capabilities such as screen resolution, which are, to some extent, covered by our suggestion to have platform prerequisites metadata (see above), and which seem likely over time to become less significant as the specifications of entry level devices improve. Two major concerns remain:

### Offline mode

Despite rapidly improving cover, it is still the case that there are many dead spots where mobile reception is either not available or at best flaky. Underground trains provide no signal, and maintaining a mobile broadband connection in a car or on a train is notoriously difficult, particularly outside of urban areas. So long as this remains the case, arguably the most pressing technical concern that SCORM faces in the mobile domain is for it to be able to operate in an offline mode.

The current crop of mobile SCORM players recognise this difficulty. Without exception, they simulate an online server by providing local caching for data, which should be stored in the LMS data model. Cached material is later uploaded as and when the device goes online. While functional, the solutions adopted are bespoke, and the authors feel that it would be more appropriate to build support for local caching into the SCORM standard itself.

### Dynamic loading of content

The current trend amongst mobile service providers seems to be away from the 'eat all you want'

model of bandwidth provision towards a much more limited one. Even so-called 'unlimited' data packages tend to have a fair-use policy of at most a few gigabytes, above which the user pays a premium. This constraint hits private users particularly hard, as they must pick up the tab out of their own pocket. Corporate users are perhaps better isolated, because 'the company pays.'

To address this issue of limited data allowances, we suggest building support for on-the-fly loading of data into a SCORM content package. If required files could be downloaded (or, in many circumstances, side-loaded to avoid the need for any data allowance usage at all) dynamically, then it would be a significant boon to mobile users. It might also increase the potential for non-linear learning, since the entire content set would not need to be downloaded in one go. Instead, what is needed would be accessed as required.

Clearly this needs to be balanced with the need for an offline mode, but the provision of options for both this and dynamic data access would make SCORM very flexible in the m-learning context.

## 5.6 SCORM compliance and certification

Currently, SCORM compliance is a label which indicates that a vendor of a SCORM product believes it to meet a SCORM standard (be it SCORM 1.2 or 2004). Essentially it is self-certification, and while ADL provide a suite of tools to test for compliance, there is no rigorous process to go through.

Certification is a higher standard. ADL issues the following advice about it:

*'When using standards, the appropriate term is compliance. You either comply with the standard, or not. The path to certification is compliance. A product that is SCORM certified has been independently tested by one of the ADL Certification Testing Centres and after passing the SCORM Test Suite, becomes 'ADL Certified.' ADL certification assures consumers of distributed learning content and systems that certified products have successfully implemented SCORM's requirements.'*

Unfortunately, certification has not been widely adopted. At the time of writing, ADL listed only 306 products (including LMSs, content and authoring tools) as being certified.

It seems to the authors that there is a good argument for encouraging certification. A variegated system might even be put in place to demonstrate adherence to requirements for e-learning vs m-learning.

For example, were it possible to reach an agreed definition for SCOs, this might be limited to being an m-learning standard. As has been mentioned, existing SCORM packages used in e-learning that are essentially an entire course in a single, large SCO are perfectly supported by the standard and are used successfully. However, they are unlikely to be suited to m-learning, and so a 'mobile suitable' label for new SCORM content might be thought desirable.

## 5.7 Recommended further research

On the technical side there is a need to better define some the ideas raised by the authors in the previous pages, but there is also a need to verify the usefulness of these. This needs to be done from two different angles:

- From the learners side: Do these technical suggestions offer anything that does not already exist in SCORM, and would learners benefit from it?
- From the instructional designer side: Are designers likely to use these new functionalities frequently enough to merit their development?

On the cognitive side more research is needed to assess the importance of a learner obtaining information at the point of need. Does this lead to greater retention? Or does the distraction of being engrossed in a task (and therefore not being able to engross oneself in the linear act of learning) have a detrimental effect on the understanding and retention of the newly acquired knowledge?

We acknowledge that this recommendation does not relate to a 'pure' SCORM activity but its importance to the way that mobile learning is used in the field cannot be underestimated. If further research discovers that learning at the point of need is detrimental to the learner's retention, then there is a need for more investment in traditional training solutions. However, if the learning at the point of need has a positive effect on retention, transfer and understanding, it might be worth re-examining how this can be better worked into a traditional learning agenda.

Further research into the applicability of tracking location data—the ability to describe a path or list of locations as part of a learning activity—is critical to understanding the way in which this recommended expansion should be developed.

## 6 Conclusions

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Mobile phones are on their way to becoming the primary way we connect to the Internet. With the younger generations driving this trend (EIAA, 2010) mobile learning is enjoying a similar growth. Just like e-learning before it, mobile learning will become one of the tools that trainers use on a daily basis and, as such, will be part of the blend.

As described in section 2 of this document, mobile learning is based on ubiquitous devices that do not require going into 'learning mode.' This means that the fit into the blend needs to be considered carefully: mobile learning can offer a much greater variety than PC-based e-learning. However, this is not to say that mobile learning—like e-learning before it—will not benefit greatly from standardization.

In this context the adaptation of e-learning standards depends largely on the type of learning activity—after all most standards were designed for a very different type of learning. When focusing specifically on the SCORM standard it is hard to ignore the process leading to the creation of SCORM 2.0—some of the suggestions made in this document will benefit the standard regardless of its mobile incarnation (and are in line with some of the existing change proposals).

If the mobile learning market is to avoid fragmentation and lack of compatibility, flexible standards are urgently needed. The SCORM standard provided a base for a coherent e-learning market—this success can be repeated within the m-learning market and will require the working of flexibility into the standard and a clear definition of what the standard is and is not out to cover.

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