
**Information technology for learning,
education and training — Nomadicity and
mobile technologies —**

**Part 2:
Learner information model for mobile
learning**

*Technologies de l'information pour l'apprentissage, l'éducation et la
formation — Nomadisme et technologies mobiles —*

*Partie 2: Modèle d'information des apprenants pour l'apprentissage
mobile*

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Foreword

ISO (the International Organization for Standardization) and IEC (the International Electrotechnical Commission) form the specialized system for worldwide standardization. National bodies that are members of ISO or IEC participate in the development of International Standards through technical committees established by the respective organization to deal with particular fields of technical activity. ISO and IEC technical committees collaborate in fields of mutual interest. Other international organizations, governmental and non-governmental, in liaison with ISO and IEC, also take part in the work. In the field of information technology, ISO and IEC have established a joint technical committee, ISO/IEC JTC 1.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of the joint technical committee is to prepare International Standards. Draft International Standards adopted by the joint technical committee are circulated to national bodies for voting. Publication as an International Standard requires approval by at least 75 % of the national bodies casting a vote.

In other circumstances, particularly when there is an urgent market requirement for such documents, the joint technical committee may decide to publish an ISO/IEC Technical Specification (ISO/IEC TS), which represents an agreement between the members of the joint technical committee and is accepted for publication if it is approved by 2/3 of the members of the committee casting a vote.

An ISO/IEC TS is reviewed after three years in order to decide whether it will be confirmed for a further three years, revised to become an International Standard, or withdrawn. If the ISO/IEC TS is confirmed, it is reviewed again after a further three years, at which time it must either be transformed into an International Standard or be withdrawn.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO and IEC shall not be held responsible for identifying any or all such patent rights.

ISO/IEC TS 29140-2 was prepared by Joint Technical Committee ISO/IEC JTC 1, *Information technology*, Subcommittee SC 36, *Information technology for learning, education and training*.

ISO/IEC TS 29140 consists of the following parts, under the general title *Information technology for learning, education and training — Nomadicity and mobile technologies*:

- *Part 1: Nomadicity reference model*
- *Part 2: Learner information model for mobile learning*

Introduction

This part of ISO/IEC TS 29140 provides guidance regarding the use of a learner information model for mobile learning that can be used as a reference by software developers, implementers, instructional designers, trainers, automated systems, and learning management systems to ensure that learning, education, and training environments reflect the specific needs of mobile participants. In addition, this part of ISO/IEC TS 29140 provides a definition of mobile learning, and it delineates the relationship between mobile learning and nomadicity.

As schools, governments, organizations, and businesses around the world design information for access by mobile devices, there is an increased need to set standards for how information should be designed for delivery on mobile devices to support learning, education, and training. This increased need is necessitated by demand for learning and training materials that can be shared easily between organizations and learners and made available to those in any geographical location. Mobile learning has the potential to provide learners with enhanced access to information and learning materials, guidance and support from anywhere rather than from a specific geographical location at a certain time. When mobile learning is implemented thoughtfully and well, it potentially may increase efficiency and productivity for learning, education, and training within different sectors (e.g. public, private, voluntary). Mobile learning has the potential to provide learners with new opportunities to connect with other learners, to interact with instructors, and to co-create collaborative learning environments. This is a critical issue for learners who live in remote locations lacking wired connections. Learners living in these remote locations can use mobile technologies with wireless capabilities to connect with others in different locations. As a result, remote learners might feel less isolated, which could result in more learners completing their learning, education, or training activities using mobile technologies.

This part of ISO/IEC TS 29140 focuses on a device-centric approach to mobile learning. It acknowledges the affordances and limitations of devices to access resources and to support learners participating in activities within information technology for learning, education and training (ITLET) systems. In contrast, ISO/IEC TS 29140-1 focuses on providing a nomadicity reference model that describes the elements that need to be considered when learners are attempting to access resources and complete ITLET system activities while moving from location to location. It includes a description of the elements of learning environments from multiple perspectives. If mobile devices are being used and learners are nomadic, then both ISO/IEC TS 29140-1 and this part of ISO/IEC TS 29140 would be consulted. If, on the other hand, learning activities solely involve the use of mobile devices, then only this part of ISO/IEC TS 29140 would be consulted.

There are a number of research teams in organizations and communities who are working on mobile learning. Additionally, work is already in progress in various countries around the world on related topics such as learning in different contexts, learning while on the move, and the use of handheld computers in learning. Work is in progress on some of these issues at the W3C and the ITU-T. As this work progresses it is essential to prepare the groundwork to ensure that the design, development, implementation, and evaluation of mobile learning within learning, education, and training environments will take place in a manner that is seamless, flexible, and integrated. In short, mobile technology needs to be seamlessly integrated into teaching and learning activities that are supported by information and communication technology (ICT) in general.

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Information technology for learning, education and training — Nomadicity and mobile technologies —

Part 2: Learner information model for mobile learning

1 Scope

This part of ISO/IEC TS 29140 provides a learner information model specific to mobile learning that can be used as a reference by software developers, implementers, instructional designers, trainers, automated systems, and learning management systems to ensure that learning, education, and training (LET) environments reflect the specific needs of mobile participants. Since these needs impact on other standardization efforts and other work items in LET, a concise view is necessary.

This part of ISO/IEC TS 29140 provides

- a definition of mobile learning that is appropriate for all sectors in LET,
- the description of the learner information model for mobile learning,
- specific learner information that supports learners engaged in mobile learning activities in LET environments.

In addition, this part of ISO/IEC TS 29140 provides some initial guidance regarding the issue of privacy. This includes ensuring that this part of ISO/IEC TS 29140 does not contravene any privacy requirements.

1.1 Exclusions

The scope of this part of ISO/IEC TS 29140 does not include the following:

- in-depth technical review of issues related to adaptability to culture, language, and individual needs;
- broad or in-depth technical interoperability issues of mobile computing domains;
- security;
- authentication.

1.2 Areas not currently addressed

This part of ISO/IEC TS 29140 currently does not include

- in-depth details regarding privacy,
- accessibility, and
- detailed information regarding complementary work within other organizations that might be relevant (ITU-T, W3C, etc.).

2 Normative references

No normative references are cited.

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1

learner information

recorded information associated with learners and used by **learning technology systems**

NOTE Learner information may be created, stored, retrieved, used, etc., by learning technology systems, individuals (teachers, learners, etc.), and other entities.

[ISO/IEC 2382-36:2008 (36.07.01)]

3.2

learning

acquisition of knowledge, skills or attitudes

[ISO/IEC 2382-36:2008 (36.01.01)]

3.3

learning technology system

LTS

information technology system used in the delivery and management of **learning**

3.4

mobile learning

learning using information and communication technologies in mobile contexts

NOTE Other definitions reviewed during the development of this definition of mobile learning are included in Annex C.

3.5

nomadicity

tendency of a person, or a group of people, to move from one location to another with relative frequency

EXAMPLE The learner has to access the learning materials from different locations, varying time zones and within another environment during a single learning episode.

[ISO/IEC TS 29140-1 (3.2)]

3.6

ubiquitous learning

learning that is stimulated and supported through diverse channels and always readily accessible

4 Abbreviated terms

DRC digital reference centre

DRR digital reading room

DTPR digital thesis and project room

ESL English as a Second Language

ICT	information and communication technology
IEEE	Institute of Electrical and Electronics Engineers, Inc.
IMS	IMS Global Learning Consortium, Inc.
IEC	International Electrotechnical Commission
ISO	International Organization for Standardization
ITLET	Information Technology for Learning, Education and Training
ITU-T	International Telecommunication Union – Telecommunication sector
LET	Learning, Education and Training
LMS	Learning Management System
LTS	learning technology system
W3C	World Wide Web Consortium

5 Examples of mobile learning applications

As the use of mobile devices grows around the world, the infrastructure to support mobile learning is being improved to allow access anywhere and anytime to learning applications, services, and content. In several countries, corporate, academic and government organizations are using existing Learning Management Systems (LMS) to implement and provide support for mobile learning. In some countries connectivity is sufficient to allow learners to access learning resources and participate in teaching and learning activities through connecting to networks using mobile devices. There is a shift from wired to wireless connection that will facilitate the use of mobile technology in learning.

Mobile learning is being used to improve access to learning materials and services that will facilitate individual learning, education, and training from anywhere and at any time. Below are some specific examples of mobile learning applications.

- In large geographically dispersed countries, mobile learning is used to facilitate the delivery of information and learning materials to learners in any geographic location. Universities are developing digital repositories that have courses that link to learning resources, allowing learners to access course materials from anywhere and at any time using a variety of technologies, including mobile technology.
- Mobile learning is being used to train immigrants who require language instruction in a second language while they work at the same time. Organizations are converting courses for mobile delivery. These allow independent learning and the convenience of learning.
- Organizations are converting courses for mobile delivery for the convenience of learning at a time and place that meets individual learners' needs.
- Mobile learning applications are being used to
 - Send daily information from university to student;
 - Gather immediate feedback and response data from students using mobile phones as part of a classroom response system;
 - Assess learner's level of understanding or skills, associated with rich media content;
 - Browse videos of recorded lectures;
 - Support Problem-Based or Collaborative Learning in real situations, such as exploring museums or cities to find out relevant information to solve a given problem;
 - Provide grammar lessons with interactive exercises to anyone with a mobile device that can access the internet, particularly new foreign workers needing ESL training to enter the workforce, adult learners needing skills update and others who might want easy access to grammar training. This project is summarized in Annex D;

- Allow mobile learners to access learning and reference materials from anywhere and at anytime. A Mobile Library (M-library) website, for example, provides a wide range of digital resources and library services, including digital reading room (DRR, e-course reserve), digital reference center (DRC), digital thesis and project room (DTPR), Help centre, search engine, and journal databases. This project is summarized in Annex D;
- Support interactions with an intelligent software agent capable of adapting to the heterogeneous mobile computing environment. The agent can search for a conversion tool according to the desired format and convert the course materials automatically. The agent is able to understand mobile clients' device capabilities. In order for the server to know what type of course material the client wishes to receive, the client needs to provide information on the software and hardware capabilities of the device to the server. However, devices do not normally carry any information about their capabilities. This project is summarized in Annex D.

6 Learner information for mobile learning

Information about the learner is used to determine how required learning materials infrastructure and support are all tailored for mobile learning. Learner information for mobile learning is similar to learner information for e-learning. Additional learner information is required to support mobile learning in different situations that may reflect contextual elements such as the mobility of the learner and the nature of the surrounding environment (e.g., infrastructure to support ubiquitous learning). As noted by several leading researchers in the field, the use of mobile devices to support mobile learning may be considered along different dimensions including the mobility of the learner and the embeddedness of the learner in the real environment or in context. In e-learning with desktop or notebook computers, the learner mobility and embeddedness are low. In mobile learning, learner mobility and embeddedness are high (Lyytinen & Yoo, 2002). To adequately support mobile learners engaged in learning, education, and training activities, information technology systems need to consider the specific context of the mobile learner with respect to dimensions such as mobility, embeddedness, learner preferences, content, device capabilities, and coordination.

Mobile learning provides flexibility for learning since it enables learning facilitated by a diversity of mobile devices. Mobile learning content is delivered in chunks and the mobile device can allow for synchronous, spontaneous interactions. In mobile learning the learner is always connected and learning is networked because of the connectivity of the mobile device (Cobcroft, 2006). Due to the limitations of e-learning where the learner may be tied to one wired location, learning may occur in simulated environments. Mobile learning provides learners with opportunities to learn outside of the classroom since the learner can learn from anywhere and at any time. Organizations use both e-learning and mobile learning; however, mobile learning provides more flexibility to learn and allows improved communications between learners and between learners and teachers. Further information is provided in clauses 6.2 and 6.3 regarding elements that are common to both e-learning and mobile learning and elements that are unique. However, there will be unique learner information elements for mobile learning, which are identified in clauses 6.2 and 6.3.

6.1 Learner information model for mobile learning

During the review of Use Cases provided, certain elements were identified as being minimum recommended elements to support learners and others were identified as optional. A more detailed listing of the use cases reviewed is provided in Annex D. Following the review, common aspects were identified and form the basis for the learner information model for mobile learning (see Figure 1 below). The learner is at the center of the model. Other aspects that are part of the model and impact on learner experience include content, device, coordination, connectivity. Minimum recommended elements have been identified based on the use cases submitted. These elements are identified in clause 6.2. Each minimum recommended element has been included under the relevant aspect of the learner information model for mobile learning. There are also optional elements included in clause 6.3 that have been grouped under the related aspect.

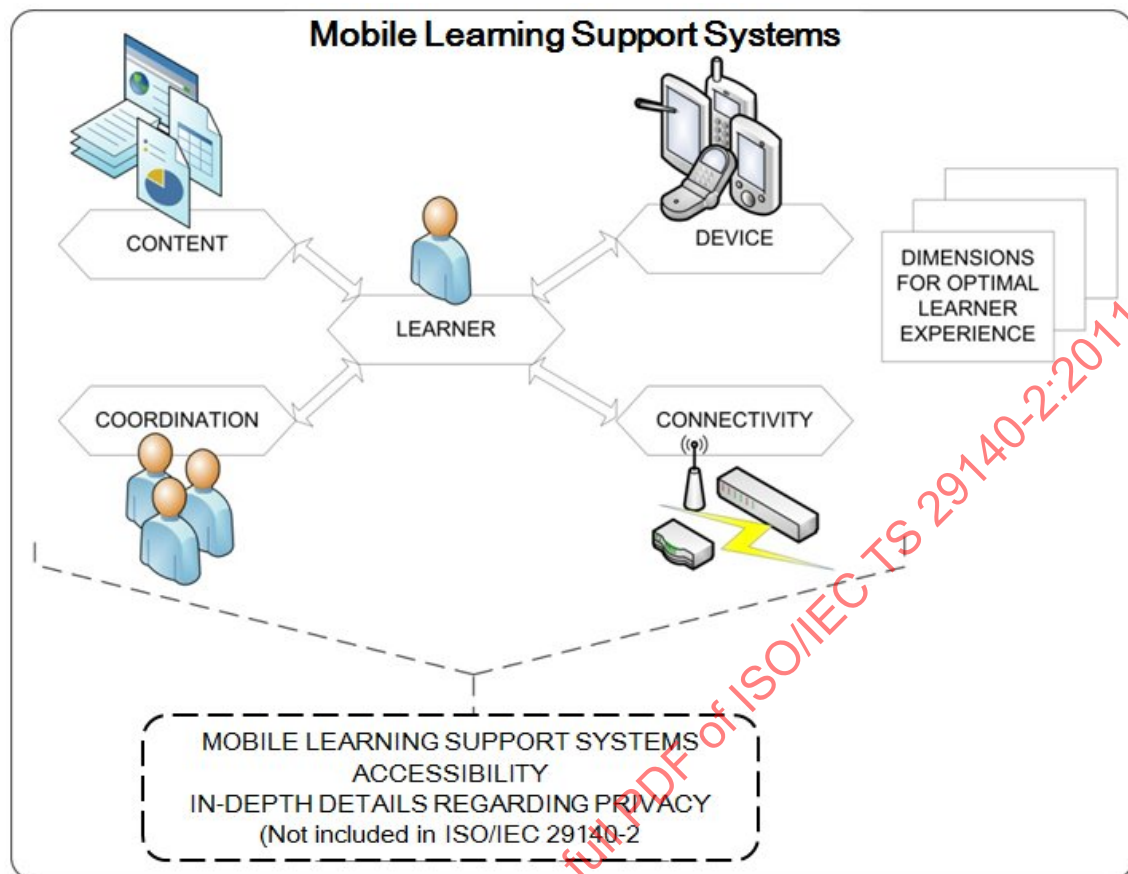


Figure 1 — Learner information model for mobile learning

It should be noted that the optional elements subclause is not exhaustive, and is further expanded in clause 6.4 Dimensions for optimal learner experience. Ideally, the elements within each aspect of the learner information model for mobile learning may be viewed as dimensions that when considered holistically can assist in providing an optimal experience for learners engaged in mobile learning activities. It should be noted that mobile learning activities are inherently dynamic, connectivity can change during sessions, learner preferences for presentation may change depending on external factors such as noise in the surrounding environment, or internal factors such as fatigue. Although in-depth details regarding privacy are beyond the scope of this Technical Specification, several elements have been noted as possibly having potential privacy issues. Further discussion regarding possible technical solutions to these potential privacy issues currently is not included in this Technical Specification, but may be included in future editions, or in companion standards or technical reports.

6.2 Minimum recommended learner information

Based on a review of use cases outlined in Annex D, there are minimum recommended learner information elements that must be considered in mobile learning systems to support learners. These minimum recommended learner information elements are given in Table 1. The recommended elements with an asterisk (*) are specific to mobile learning. The other elements apply to both mobile learning and e-learning.

Table 1 — Minimum recommended elements — Learner information model for mobile learning

	Minimum recommended learner information	Description
LEARNER		
6.2.1	Learner identification	This includes username and password so that the learner can access the information from anywhere and anytime.
6.2.2	Geographical location of the learner* NOTE: There may be privacy considerations regarding the recommended use of this element. Location settings may be used to determine surrounding infrastructure support for the purposes of coordination of information.	As the learner is mobile, it is important to know where the learner is located so that the learner can apply the information in the appropriate context, and in a manner that is consistent with the specific situation of the learner.
6.2.3	Learner history NOTE: There may be privacy considerations regarding the recommended use of this element. Learner history information is specific information relevant to support adaptive interactions between the learner and the IT system.	Previous learning activities of the learner and the learning levels that were attained.
6.2.4	Learning needs	The learning outcomes the mobile learning is intended to support and the learner would like to achieve.
6.2.5	Learner progress NOTE: There may be privacy considerations regarding the recommended use of this element. The information may be restricted to those who have specific roles within the IT system.	How is the learner progressing in the learning process?
6.2.6	Language of the learner NOTE: There may be privacy considerations regarding the optional use of this element. The information may be restricted to those who have specific roles within the IT system.	The learner should be able to access learning materials in her or his first language or the language that is being learned. If the learning materials are not available in different languages, ideally the system should enable translation of the learning materials to the learner's preferred language.

	Minimum recommended learner information	Description
DEVICE		
6.2.7	Type of device being used*	The system must know the type of mobile device the learner is using so that the information can be formatted for the specific device.
CONNECTIVITY		
6.2.8	Connection speed*	The speed of the connectivity so that information can be downloaded to the learner in an efficient manner. For example, if the learner has a slow connection speed, the learner should not be required to access large amounts of data.

6.3 Optional learner information

There are optional learner information elements that may be considered in mobile learning systems to support learners. These optional learner information elements are given in Table 2. The optional elements with an asterisk (*) are specific to mobile learning. The other elements apply to both mobile learning and e-learning.

NOTE Table 2 is not exhaustive. Additional optional learner information that contributes to optimal mobile learner performance is discussed in clause 6.4.

Table 2 — Optional elements - learner information model for mobile learning

	Optional learner information	Description
LEARNER		
6.3.1	Learning style of the learner NOTE: There may be privacy considerations regarding the optional use of this element. The information may be restricted to those who have specific roles within the IT system.	If the learning style of the learner is known, then the system could suggest learning activities based on the learner's learning style.
6.3.2	Learner academic background NOTE: There may be privacy considerations regarding the optional use of this element. The information may be restricted to those who have specific roles within the IT system.	Knowing the learner academic background could help to ensure that the appropriate content is presented to the learner at the right time and level.
6.3.3	Learner display preferences*	Before the correct mobile device is given to the learner, the learner display preferences must be known. For example, if the learner requires that text is presented on a high contrast background, then the mobile device must meet the display and delivery requirements of the learner.
6.3.4	Motivation level of the learner	Motivation level of the learner to learn in a situation that requires mobility or the use of a mobile device.

CONNECTIVITY		
6.3.5	Electrical capabilities*	The electrical capabilities of the geographical location of the learner must be known so that the appropriate device can be given to the learner to access the information.
COORDINATION		
6.3.6	Coordination of other access (e.g., tutor, peer, instructor)	Provide the ability to allow the learner with access to tutors, peers, or educators for help while learning if needed.
6.3.7	Learning group	Identification of the group to which the learner belongs so that communities of learners can be formed.

6.4 Dimensions for optimal learner experience

The information about the learner is used to determine how learning materials are developed, delivered and rendered for mobile learning. As noted above, it is the learner and the learner experience that is key to the success of mobile learning activities. The following subclauses provide additional details and describe how mobile learning materials should be designed and developed based on the learner information and to meet the needs of the learner. All of the aspects of the learner information model for mobile learning are discussed and suggestions are provided to ensure an optimal learner experience. The information is organized using the dimensions proposed by Goh and Kinshuk (2005).

The following design elements should be considered when designing learning materials for mobile learning.

- Learning is self-directed where the learner controls the speed of the learning.
- Learning is ubiquitous where learning can take place anywhere and at any time.
- Learning, education, and training activities need to be supported reliably and with seamless connectivity.
- Build a learning community to support the collaborative work of learners who feel comfortable working in groups.

6.4.1 Learner dimension

As noted above there are certain minimum recommended learner elements that should be considered by designers, implementers, and others.

- **Learner identification** – This is used to uniquely identify the learner so that appropriate access is provided to learning resources. It includes a username and password.
- **Geographical location of the learner** - It is important to know the geographical location of the learner so that the appropriate learning activities can be presented in the current context of the learner who is mobile and could be in different geographic locations at different times.
- **Learner history** – This involves the previous learning activities of the learner and the learning levels that were attained.
- **Learning needs** – The learning outcomes the mobile learning is intended to support and the learner would like to achieve.
- **Learner progress** – Information regarding how the learner is progressing in the learning process.

- **Language of the learner** – The learner should be able to access learning materials in her or his first language or in the language that is being learned. If the learning materials are not available in different languages, ideally the system should enable translation of the learning materials to the learner's preferred language.

Additional optional learner elements are provided below.

- **Learning style of the learner** – It is important to know the learning style of the learner since different learners have different learning styles and some learners may be more visual while others may be verbal (Mayer & Massa, 2003). The right learning content and services that are provided to the learner in mobile learning would depend on the learning styles of the learner. For example, if the learner has a reflective style, then the mobile learning delivery system should use asynchronous communication to allow learners to reflect before they respond to comments and questions. Different learners have different learning styles and some learners may be more visual while others may be verbal.
- **Learner academic background** – Before the appropriate content is provided to the learner, it may be helpful if the content is provided at the right level. Having information related to learner academic background could help to determine the right level of information to provide to the learner.
- **Learner display preferences** - Individual learners have specific preferences that should be considered during the learning process. For example, if the learner requires that text is presented on a high contrast background, then the mobile device should meet the display and delivery requirements of the learner.
- **Motivation of the learner** - Learner motivation can impact positively or negatively on learning outcomes. Technologies need to support learner motivation to impact positively on learning outcomes. Hence, mobile learning materials should use strategies to continually motivate and engage learners.

6.4.2 Content dimension for individual learner needs

The content dimension suggests that the system should have capabilities for organizing and selecting the appropriate content and for delivering content according to the learning situation so that learner needs are met.

Optional information elements for content that support learners in mobile learning situations are listed below.

- **Course module** - Courses may be delivered in the form of modules. The modules are then broken down into smaller chunks based on the learning objectives in the modules. Modularizing courses can allow learners to complete a small segment of a course before moving on to other segments. Identifying content with course modules can help with monitoring learner progress through content and with delivery of appropriate content.
- **Granularity level** - Mobile learning materials may be developed in chunks to allow for flexibility in delivery for the learner. Learning materials are often packaged in manageable interconnected chunks to allow learners to access a small segment of a lesson at a time. This can make learning easier on mobile devices and learners may get a sense of accomplishment after completing each linked segment of a lesson. Information should be chunked in segments of appropriate and meaningful size to facilitate cognitive processing.
- **Sequencing** - Mobile learning materials need to be sequenced appropriately in order to provide access to materials in a manner that is consistent with the needs of the learner.
- **Multimedia** - Mobile devices should have multimedia capabilities to meet the needs of those with different learning styles and accessibility requirements. Recent research studies have shown the benefits of the use of mobile phones with multimedia capabilities in language learning. Researchers are currently investigating the use of voice input for mobile devices to improve efficiency when inputting data into mobile devices. For example, voice input may be supportive for use in learning activities related to field work in engineering and science and in a range of learning situations, especially language learning. Learning materials should be presented in multimedia formats to capitalize on the capabilities of the mobile device. For example, video segments can be presented to deliver rich information segments and audio will allow learners to listen to information anytime and anywhere.

- **Pedagogy** – Identification of the pedagogical basis for content may help in the delivery of content to meet learning needs of mobile learners. For example, pedagogical considerations may involve structuring of learning content to support social constructivist approaches to learning activities. Alternatively, a behaviourist approach could be used to reinforce the development of fundamental knowledge required for application in an activity. Cognitive approaches could be used to develop learner metacognitive skills.

6.4.3 Device capability dimension to maximize the use of the mobile device

The device capability dimension suggests that the adaptation framework should have the capability for identifying and utilizing some or all of the device capabilities.

The minimum recommended information for device is listed below.

- **Type of device being used** – The system should know the type of mobile device the learner is using so that the information can be formatted to the specific device. This recommended information can be linked to other optional elements listed below to provide an optimal experience for the mobile learner.

Suggested optional information elements for device are provided below.

- **Presentation capability** - Designers of materials for mobile devices should use presentation strategies to enable learners to mentally process the materials efficiently. Of primary concern are questions regarding presentation capability to support content being used. Does the device have the presentation capability to support the display of the size and portability of the content being used? Due to the small input and output components of mobile technology, there are design implications for learning materials for mobile learning. For example, rather than scrolling through information on the screen, users of mobile technology should be able to go directly to the information and move back and forth with ease. To compensate for the small screen size on mobile technology, learning strategies should use rich medium to convey the message to the learner. For example, rather than present information in textual format, graphics and pictures can be used in such a way to convey the message using the least amount of text. To present procedures and real life situations, video clips can be used to present real life simulations to the learner. Pictures and graphics can be used as overviews to give learners the big picture before they go into the details of the information. For the active learners, information can be presented on the mobile device and then the opportunity given for the learner to apply the information. For the creative learners, there should be opportunities to apply the information in real life applications so that they go beyond what was presented. When designing learning materials for access by mobile devices, educators and trainers need to move away from presenting information in a linear, textual format to a more graphical and hypertext format. The information can be presented in the form of a concept map or network diagram. A concept map or a network diagram can be used to show the important concepts in the information and the relationship between the concepts rather than present information in a textual format. In addition to the above design strategies, trainers need to design learning material for just in time access and immediate application since learners on the job may need to acquire knowledge and skills for immediate application.
- **Interface** - The interface for mobile devices should adapt to the learner rather than requiring the learner to adapt to the interface. The interface can be graphical and should present limited information on the screen to prevent information overload. The mobile learning system should have some built-in intelligence to anticipate what the learner will do next and then provide the appropriate information and interactive activities. A good interface for learner access should reduce information overload by presenting less concepts on one screen or organizing the information in the form of concept maps to give the overall structure of the information and then presenting the details by linking to other screens. At the same time, the interface should also use good navigational strategies to allow learners to move back and forth between displays. The interface to the mobile technology should be appropriate for individual learners and intelligent software systems should be developed to customize the interface for individual learners.
- **Privacy** - The mobile learning system should protect the privacy of learners since the system may have the capability of monitoring where the learner is located as the learner moves around and what the learner is doing without the learner being aware of being monitored (Kindberg & Barton, 2000). The transfer and storage of information may be needed to support adaptive interactions intended to enhance learning. At the same time, the transfer and storage of this information needs to respect the privacy of the learner. The use of security and authentication in order to protect privacy is beyond the scope of this Technical

Specification. However, items that require consideration with respect to privacy have been noted above. Proper security and authentication should be provided by the learning system to prevent unauthorized access to information.

- **Operational capability** - Learners should be able to access learning materials in context in both formal and informal learning settings. For example, if a learner is using a piece of equipment in a remote geographic location and would like to learn more about the equipment, the learner should be able to access information relating to the equipment. The operational capabilities of the mobile device may impact on the experience and outcomes experienced by the learner. Additionally, it is helpful if the operational capability minimizes typing required by the learner because the keyboard on mobile devices is very small. To make input more user-friendly, pointing or voice input capability can be used to minimize typing.

6.4.4 Connectivity dimension to perform at different connection speeds

The connectivity dimension requires that the system should have the capability of deciding which mode of operation is best suited for the connectivity condition.

The minimum Recommended connectivity information to support optimal learner experience is provided below.

- **Connection speed** – The speed of the connectivity so that information can be downloaded to the learner in an efficient manner. For example, if the learner has a slow connection speed, the learner should not be required to access large amounts of data.

Optional information elements to support optimal learner experience are provided below.

- **Electrical capabilities** - The electrical capabilities of the geographical location of the learner should be known so that the appropriate device can be given to the learner to access the information.
- **Real-time or online mode** - The mobile learner may access content or participate in learning activities either in real-time (synchronous) or in an online mode that is asynchronous.
- **Integration with other technologies** - Mobile technologies need to interoperate with other technologies to enable the seamless provision of learning resources to the learner.

6.4.5 Coordination

The coordination dimension requires that the system should have the capability of allowing the learner to interact and obtain feedback from others involved in the learning process and efficiently isolate the content, presentation, navigation and interaction components and subsequently integrate them seamlessly and effectively.

The optional coordination elements to support mobile learners are provided below.

- **Coordination of other access (e.g., tutor, peer, instructor)** – Provide the ability to allow the learner access to tutors, peers, or educators for help while learning if needed. In ubiquitous learning there should be ways for identifying the specific learning collaborators, appropriate learning content and required learning services in the right place at the right time (Yang, 2006).
- **Learning group** – Identification of the group to which the learner belongs so that communities of learners can be formed.
- **Presentation integration** - Mobile learning materials should be integrated for delivery on the specific mobile device being used by the learner. The system should check the type of device and then format the learning materials for learners' specific devices.
- **Interactivity** – The content and learner activities need to be coordinated to provide the appropriate level of interactivity for the individual learner and others involved in the learning process.

- **Navigation** – Seamless navigation for the individual learner requires coordination of content and learning activities in a manner that respects the different levels of learner background experience and expertise. Alternative navigation pathways may need to be provided to the same content and learning activities, depending on the individual learner elements (e.g., learner display preferences, etc.).

7 Additional considerations

Mobile devices have been around for many years but are becoming more sophisticated. At the same time, there remain limitations and challenges when using mobile devices. For example, some learners find that the screen size is small when reading information and the keyboard too small for entering information. To help with these limitations, researchers are developing mobile devices with virtual screens and keyboards which will help to overcome some of these challenges and limitations. Since there are more learners around the world today with mobile devices compared to desktop computers, it is crucial that standards be developed for design and delivery of information on mobile devices to make the learning process seamless and transparent for the learner.

At the same time, the learning materials developed for delivery on mobile devices should be suitable for different cultures and contexts. For example, standards developed for mobile devices should apply to different cultures since wireless mobile technology allows anyone from anywhere to access learning materials. Also, there should be standards for mobile learning that apply in different contexts. For example, it may be helpful to have guidelines or standards regarding the design of information for access while working off-site in the field.

There are other groups and committees undertaking work related to mobile learning who may be interested in this Technical Specification. These groups and committees include: Open Mobile Alliance, the W3C Ubiquitous Web Applications group (formerly the Device Independence Working Group) and the JTC1 Special Working Group on Accessibility. Further work is required to ensure integration with these efforts.

As learners move from one place to the next, they should be able to use computing devices and communication technology to access information and learning materials from anywhere and at anytime. Having the ability to access and use computers from anywhere is referred to as nomadic computing. This gives learners the ability to access information and learning materials from anywhere and at anytime and will facilitate mobile learning, which also is referred to as “learning on-the-go”. The use of mobile computing devices to access learning materials must be transparent to the learner and at the same time support their specific learning needs. For nomads, the infrastructure must be in place to make sure there is access to learning materials and support as learners move from one geographic location to the next. To allow transparent access of learning materials from anywhere, international standards specific to and supportive of learner needs for nomadicity and mobile learning must be in place.

Annex A (informative)

Referencing Explanatory Report (RER)

Project Editors' Notes

The incoming 5th edition of the JTC1 Directives {see J1N7212} has a new Annex N which requires a "Reference Explanatory Report" (RER) to be provided for each "Referenced Specification (RS) to be provided.

It will be useful to keep these "RERs" and include them in an "Informative Annex".

Here is the RER for the RS contained in this CD ballot document.

RER #01:	
RS Title:	IMS GLC Inc. IMS Learner Information Profile (LIP), Version 1.0 and Version 1.0.1
RS Rationale:	The IMS GLC Inc. Learner Information Profile (LIP) serves as a de facto standard for developers and organizations within the eLearning community. This Technical Specification refers to the IMS GLC Inc. de facto standard and extends the LIP to identify elements that are recommended and optional to support mobile learning activities.
RS Market Acceptance:	The RS has full market acceptance.
RS Transformation into an IS:	Currently there are no plans to transform this RS to an IS. This particular Technical Specification is focused on extending the referenced specification specifically for mobile learning contexts.
RS Referencing:	This RS is publicly and freely available and maintained by IMS GLC Inc. See < http://www.imsglobal.org/profiles/index.html >.
Note:	There currently is an agreement between ISO and IMS GLC Inc. regarding Learner Information Package Accessibility for LIP (ACCCLIP) and the IMS AccessforAll Metadata. This agreement was necessary to move forward with work on the multipart standard ISO/IEC 24751.

Annex B (informative)

Background information

A questionnaire was developed to review the definitions for mobile learning and nomadicity and to gather information on mobile and nomadic learning around the world. The questionnaire was distributed to several countries. Information in this part of ISO/IEC TS 29140 includes the information received from those who responded and feedback received from the WG3 National Bodies at the WG3 meetings. Below is the questionnaire that was distributed to collect the information on mobile and nomadic learning around the world.

ISO / IEC JTC1 SC36 WG3

Questionnaire on scenarios for and essential characteristics of nomadic learning and mobile learning

Document Name: <WG3_207_nomadicity_mobile_questionnaire.doc>

Document Title: Questionnaire on scenarios for and essential characteristics of nomadic learning and mobile learning

Version: 2.0

Date: 2007-11-01

Dear colleagues,

The goal of the nomadicity and mobile learning project is to prepare a Technical Specification that will describe the needs and requirements of nomadic learners and involves a description of the elements of learning environments from multiple perspectives (e.g., business, academic, government, etc.). It will also include the learner information specific to mobile learning that can be used as a reference by software developers, implementers, instructional designers, and others to ensure that learning, education, and training environments to reflect the specific needs of mobile learners.

In order to move forward with our work, we are inviting National Bodies and Liaison Organizations (NBLOs) to provide scenarios for and essential characteristics of nomadic learning and mobile learning.

Contributors are asked to complete the questionnaire below. Please return your completed questionnaire by email to the WG3 Convener Bernard Blandin: bblandin@cesi.fr

The deadline for submission: 15th of January 2008

If anyone has any questions on completing the Questionnaire that they should contact the Project Co-Editor, Dr. Mohamed Ally at e-mail address:

mohamed@athabasca.ca

Answer the questions from the perspective of your country or your JTC1/SC36 mirror committee.

WG3 members will analyse the scenarios and essential characteristics provided, and these will form the basis for WG3 work on nomadicity and mobile learning.

THANK YOU FOR YOUR CONTRIBUTION!

STANDARDSISO.COM : Click to view the full PDF of ISO/IEC TS 29140-2:2011

Please provide your documentation based on the following framework

Contact Person (Name and E-Mail):	
Name of the Organization:	
Address:	
Primary function or activities or business:	(For example, tertiary educational institution, government department, corporation.)

1. Nomadic Learning

It has been suggested that nomadity “refers to the system support needed to provide a rich set of capabilities and services to the nomad”, also referred to as the infrastructure, as this person “moves from place to place in a transparent and convenient form” (Kleinrock, 1996). There are currently several approaches in different countries to nomadity within learning, education, and training. Increasingly, people (e.g., workers, students, etc.), are required to accept a nomadic lifestyle, which may involve changing geographic location, time zone, and technological surrounding infrastructure. In addition, new technologies that support nomadic learners are being developed and implemented.

For the questions below, we ask that you consider the characteristics and needs of the learner who requires technologies to support their learning as they move from place to place. Some examples may include students who access their course materials on a virtual hard drive or server that is accessible from anywhere in the world, corporate learners who use mobile devices to complete assessments within a Learning Management System (LMS) learning module, government employees from different geographic locations who share and collaboratively develop policy documents across different time zones.

- 1.1 How is “nomadic learning” being implemented in your country? Please provide some examples or scenarios of “nomadic learning” in your country.
- 1.2 What infrastructure exists in your country to support “nomadic learning”?
- 1.3 Does your country have existing frameworks or standards for “nomadic learning”? If yes, please attach details of the frameworks or standards for “nomadic learning” that exist in your country.
- 1.4 What are some characteristics that a “nomadic learning” system must have to meet learners’ needs? What should a “nomadic learning” system provide for learners?
- 1.5 Based on nomadic learning that is within your own country, what is your definition for “nomadic learning”?

2. Mobile Learning

It has been suggested that mobile learning is “e-learning facilitated by mobile devices and not constrained by location or movement” [ISO/IEC 2382-36:2005 (E/F), 36.01.05]. However, within different research domains, and within JTC1 SC36 itself (e.g., 36N1349, German presentation Wuhan 2006, 36N1357, 36N1330, and 36N1288) several different definitions of mobile learning have been proposed. Recognizing that there are several approaches in different countries to mobile learning, additional information is needed to harmonize our understanding of mobile learning.

For the questions below, we ask that you consider the characteristics and needs of the learner who uses mobile devices to support their learning. Scenarios may include learners who engage in activities:

- within one geographic location and at one time (for example, using mobile devices to demonstrate the principles of germ transmission to young students in the classroom);
 - in one geographic location across different timespans (for example, using GIS handheld units to gather data for a series of fieldtrips for a Forensic Anthropology class);
 - occurring in different geographic locations at the same time (for example learners at a museum access multimedia information regarding exhibits from different locations and communicate and compare information with their colleagues/co-learners synchronously);
 - occurring across different timespans (for example gathering environmental data to track changes over time); and
 - many others ...
- 2.1 How is “mobile learning” being implemented in your country? Please provide some examples or scenarios of “mobile learning” in your country.
 - 2.2 What infrastructure exists in your country to support “mobile learning”?
 - 2.3 Does your country have existing frameworks or standards for “mobile learning”? If yes, please attach details of the frameworks or standards for “mobile learning” that exist in your country.
 - 2.4 What are some characteristics that “mobile learning” must have to meet learners’ needs? What are the features that mobile devices must have for use in “mobile learning”? What should “mobile learning” provide for learners?
 - 2.5 Based on mobile learning that is within your own country, what is your definition for “mobile learning”?
 - 2.6 Does your country differentiate between “e-learning” and “mobile learning”? If so, how?

3. Additional Information Relevant to Nomadic Learning and Mobile Learning

Please use this section to provide additional information that will help to understand the scenarios and/or characteristics you have provided. For example, please provide additional website links, definitions, and/or other documentation.

Annex C (informative)

Other definitions of mobile learning

Many other definitions of mobile learning were suggested. These include:

M-learning is e-learning with the freedom to change location while learning (*WG1/N0086*)

Mobile Learning – "Learning using mobile and wireless technologies to enhance consistent learning experience and to facilitate learner's nomadicity across different contexts" (*National Body of China*)

Mobile learning is the delivery of electronic learning materials on mobile computing devices to allow access from anywhere and at anytime (*Ally, 2004*).

m-learning can be defined as learning using mobile and wireless computing technologies in a way to promote learners' mobility and nomadicity nature (*Shon, 2008*).

M-learning is e-learning through mobile computational devices (*Trifonova & Goldfarb, 2006*).

M-learning is learning that takes place via such wireless devices as cell phones, personal digital assistants (PDAs), or laptop computers (*Shon, 2008*)

Mobile Learning – "Use of mobile devices such as mobile phones, handhelds, PDAs, iPhone 3G, etc to facilitate training, teaching and learning and to access electronic learning resources." (*Ally, M., McGreal, R., Tin., & Schafer, S., 2009*)