Towards A Contextual Mobile Learning Deployment: An Overview

Fatima Ezzahraa LOUHAB, Ayoub BAHNASSE, and Mohamed TALEA

LTI Laboratory, Faculty of Science Ben M'Sik, Hassan II University, Casablanca, 7955 Morocco

Summary
The technology evolution had a positive effect on the manner of the mobile learning development that represents a recent research field, and especially at the level of adequacy and personalization of the contents to meet the users' needs. The mobile learning has been used in various fields to benefit from its advantages for mobile users looking for a fast and easy access to the information. In this paper, we will present the definition of mobile learning by focusing on the context-awareness notion. Afterward, we will study the integration of this technology in various areas of business, transport, and education, as well as its benefits. Finally, we will specify the research field chosen while presenting an introduction of our contribution in this field.

Key words:
Mobile learning, context, context-awareness, personalization.

1. Introduction

Nowadays, the use of the mobile devices has become popular in all modern societies, and today most people can afford its costs [1]. In addition, the people's mobility became a central challenge of these societies organization. The report at time and space deeply changed with the evolution of transport and telecommunication technical systems [2]. This situation leads us to talk about the possibility of using mobile technology benefits to ensure a free, informal and contextual learning, and those are exactly the mobile learning keywords.

Over the last decade, we have become familiar with the term E-learning and now M-learning (Mobile learning) is taking its place in the learning world [3]. The M-learning is a subset of E-learning which is the macro concept that includes online and mobile learning environments. It offers greater mobility, flexibility, and convenience more than electronic learning (E-learning).

M-learning is a new research field, with the first research projects appearing in the second half of the years 1990 and the first international conferences on research less than a decade ago [4]. This concept has been defined differently according to the scientific communities, and since its birth, this term has never ceased to evolve [5].

According to Sharples [6] the M-learning definition has evolved in three axes: The learning tools, the learning out of the walls and the learners' mobility.

(i) **First axis**: The first definitions of M-learning seem centered essentially on the new mobile electronic technologies [7]. In this axis, M-learning is considered as a logical continuation of E-learning on mobile technologies [5]. Quinn declares that « Mobile learning is E-learning through mobile computational device» [8]. This definition is considered exact but useless because Quinn tries only to place the mobile learning somewhere on the spectrum of E-learning portability [9].

(ii) **Second axis**: The definitions concentrate on the potentialities in term of learning outside of the classic physical space bounded by the training room walls (a study trip, a school outing such as the museum visit, etc.) [10]. In this sense, O'Malley proposes his definition: « Mobile learning takes place when the learner is not at a fixed, predetermined location, or when the learner takes advantage of the learning opportunities offered by mobile technologies » [11].

(iii) **Third axis**: In this axis, the projects aren't focused anymore neither on the tools used by the learners nor on the activities [5]. At this level, the mobile learning begins to take into account the learner's context.

The purpose of this paper is to define the relation between the mobile learning and the context-awareness concept, as well as making a study of the works which have already responded to this issue in various fields (education, business, and transport).

Therefore, in this article, we will begin with a presentation of the context-awareness concept in relation to mobile learning. Then we will describe the works already done in this area and in various fields. Finally, we will introduce our contribution in the chosen field.

2. Context and Mobile Learning

As mobility is related to the mobile learning, the mobile devices, the capacity, the connectivity, the user and the environment can all change over the time and the place [12]. This fact, the mobile learning must dynamically adapt to the various contexts, which means it must have a context-awareness mechanism in order to ensure a contextual learning.

Manuscript received July 5, 2017
Manuscript revised July 20, 2017

2.1 Context definition

The context notion has experienced different definitions in the literature, each one defines it according to its needs and its point of view.

Abowd gives a general context definition and describes it as « Any information that can be used to characterize the situation of an entity» [13]. As Dey, in his definition, specifies the types of entities considered: «Context is any information that can be used to characterize the situation of an entity. An entity is a person, place, or object that is considered relevant to the interaction between a user and an application, including the user and application themselves» [14]. Chaari considers that this definition is incomplete since it does not specify what composes the context. So, He proposed a new definition: «The context is the whole of the external parameters to the application which can influence its behavior by defining new sights on its data and its features. These parameters have a dynamic aspect which enables them to evolve during the execution time » [15]. Syvanen develops this context property by declaring « Context is continually constructed through negotiation between communicating partners (including humans and interactive technology) and the interplay of activities and artifacts » [16].

In short, we can say that the context concept does not have a precise definition, it changes according to our needs and uses.

2.2 Context-awareness definition

The context-awareness concept was first of all introduced into the IHM field (Interactions Homme-Machine) by Weiser in 1991 to reconcile the virtual and the physical world [17]. He said that the most successful technologies are those associated with the everyday life.

The first definition of context-awareness has been proposed by Schilit [18] as the ability of a system to adapt to the execution context depending on its location, of all the people nearby, accessible equipment, etc. As, Hull, et al. [19] define the context-awareness as the ability of devices to detect, feel, interpret, and respond to the user and device environment aspects. Ryan, et al. [20] define the context-aware applications as applications that monitor the entries of environmental sensors and allow users to select the contexts according to their interests and activities. Brown [21] defines them as the applications that automatically provide information or propose actions according to the users' contexts detected by sensors. The actions can present information to the user to run a program or configure the graphical interaction according to the context. Dey [14] defines the context-awareness in a more general way: « A system is context-aware if it uses context to provide relevant information and/or services to the user, where relevancy depends on the user's task ». Byun, et al. [22] give a definition which is more generally accepted: « A system is contextual if it can extract, interpret, and use contextual information and adapt the features to the context of the current use ». These definitions are all about the ability of a device to adapt its behavior based on the user context.

2.3 Context dimensions

Given the heterogeneity, the diversity and the variable quality of this information, it is preferable to make a categorization to facilitate the adaptation operation.

Schilit, et al. [23] propose to categorize the context in two dimensions: The primary context which contains information on the location, the identity, the time and the user activity, and the secondary context which contains information that can be deducted from the primary context (for example, from a location we can deduce the people nearby). Chen and Kotz [24] propose the active context that influences the behavior of an application, and the passive context which is necessary but not critical for the application. Petrelli, et al [25] are based on the work of Schilit and Chen, and introduce two new context dimensions: The hardware context (device, existing platform, etc.), and the social context (being alone or not, who are the others, relations between these individuals, etc.).

In the learning field, time, identity, activity, and location are primary and necessary categorizations of context to explain a situation. In the work of Derntl and Hummel [26], the context is composed of five dimensions: The physical dimension, the digital dimension (digital resources), the device dimension (Software, hardware, network, portable devices), the learner dimension, and the specific context of the application field.

Pham [27] summarizes the previous proposals categorization and proposes the following dimensions:

(i) **Spatial dimension**: According to Soylu [28] this dimension defines the localization. This dimension describes the object location in the context. It is classified into two categories: Physical and virtual (i.e. the IP address is considered as a location in a network). For the physical category, the most simple form refers to the absolute position (geographical coordinates), or instead (at home, at school, train, in a radius, in a store, remote, face-to-face, etc.) [27].

(ii) **Temporal dimension**: The temporal dimension is frequently used in most of the pervasive systems to characterize the time management [29]. The most common forms to describe the temporal dimension are the time (the time zone, the current time of learning, etc.), the date (date of an activity, day of the week, months of the year, etc.), the period (the beginning and the end of an activity, etc.), the duration of an activity or the duration of a resource (15 minutes, 1 hour, etc.), and temporal relations (after, before, during, etc.) [5].

(iii) **User dimension**: It is necessary to identify the system users before the beginning of the information collect to construct the different profiles [30]. A profile management plays an important role in a learning system to adapt resources to each specific user. A user profile is a collection of data that characterize a user in a system. These data are collected by the system and classified primarily into two sets: A set of static data which includes general information about the user, such as name, surname, birth date, mother tongue, etc., and a set of dynamic data that varies with different application areas, such as goals, preferences, knowledge, skills, interests, etc. [5].

(iv) **Device dimension**: This dimension is used to measure the device characteristics. To adapt learning content to the mobile technology used by the learner it is necessary to know the properties characterizing this technology.

(v) **Environmental dimension**: In some systems, it is necessary to measure the environment characteristics around the user to trigger an alarm or to regulate the system operation.

(vi) **Scenario dimension:** As noted by Godinet and Moiraud, a scenario is “A formal representation of the organization and conduct of a learning situation in which the use of mobile functionality of digital technologies makes teaching and learning take place inside and outside the classroom walls” [32]. The activity is a key component, it determines the user's intention, information, knowledge, objects in the environment, etc., which are the necessary elements for its accomplishment [33].

2.4 Context modeling

A context model is a representation of the context information in the system. Strang and Baldauf [34][35] analyzed and identified a broad range of approaches for describing context information. According to different data structures of context information represented and exchanged, the approaches can be classified into six main types [36] :

(i) **Key-value model**: One of the first work on context modeling is published by Schilit [37]. The context information is modeled by an attribute/ value pair. The attribute represents the contextual information name and the value represents the current value of this information [38]. The advantage of this method is the ease of implementation.

(ii) **Markup scheme model**: Here, the context is modeled by a hierarchical data structure made up of tags with attributes and content. Derived languages SGML (Standard Generic Markup Language) and in particular the XML (eXtended Markup Language) are used for this modeling. The advantage of the markup language is that it allows the formatting and exchange of models between different platforms easily [5].

(iii) **Graphic model:** This method aims to model the contextual information in a conceptual graph. The most widely used model is the graphical UML (Unified Modeling Language). UML class diagrams are used to model statically the concepts that form the context as a class/association.

(iv) **Object-oriented model**: This model type takes advantage of the object-oriented method, such as encapsulation, reuse, and inheritance [36]. This approach allows representing the context elements of the classes level and objects that are encapsulated by specific interfaces. In this model, the context information is captured in the objects states.

(v) **Logic-based model**: This model method is proposed by McCarthy [39]. It is based on logical clauses. This category models the context with predicates, rules, logical operators, and facts.

(vi) **Ontology-based model**: The ontology in computer science is a structured set of terms and concepts representing a field direction of information, whether by the namespace metadata, or the knowledge field elements. This model aims to present the context by ontologies.

3. Related Works

Thanks to what the Mobile learning has offered as benefits to the users, it has been applied in various fields and disciplines to improve their performance and their needs.

3.1 Mobile learning and transport

- **CATS**

The CATS platform (Context-Aware Transportation Services Framework) [40] is a proposed approach for factorization of management applications for transport. We consider a set of applications that can run on mobile devices, accompany and support the user in his movements. The user can be in different situations, during his travels, the context changes, and so the applications used should adapt their functioning in accordance.

One of the problems related to the context is the multitude of uses that can be made of the contextual information. The interesting use in this approach is the adaptation of applications behavior according to the new situations.

The objective of this research is the proposal of a software architecture, ensuring a coherent operation of all applications that accompany a person when traveling through the use of an embedded platform for the execution and the management of the applications dedicated to transportation.

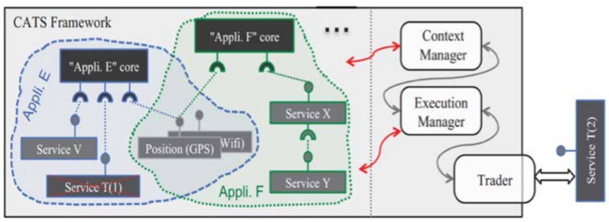


Fig. 1 The CATS platform with two examples of applications.

(i) **Context manager**: Its purpose is to detect the context and track its changes, taking into account each element characteristics.

(ii) **Execution manager**: Its goal is to ensure a good performance of the applications as well as managing their assembly.

(iii) **Trader**: Its role is to search and retrieve services from other terminals. The aim is to offer an effective solution for highly mobile users.

- **DDS**

Previously we introduced CATS, the Framework for context-aware applications for the transport sector. The use of CATS application requires a network connection. However, in specific environments, it may be impossible to use a connection. So, to overcome this disadvantage, an asynchronous approach to CATS Framework has been proposed.

This approach is presented by the DDS (Data Distribution Service) Framework [26] which is a middleware specification taking into account the quality of service properties. This new service is suitable for a new class of applications that require real-time service quality.

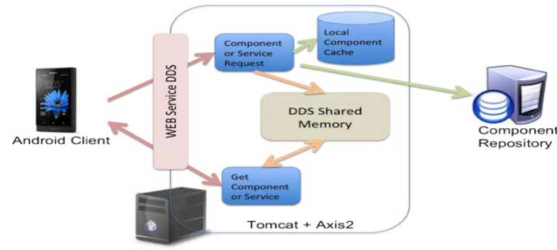


Fig. 2 DDS Framework architecture.

The environment is composed of three layers:

(i) The mobile client side that will send an asynchronous request for obtaining a software, service/component or any type of data.

(ii) The server-side who is responsible for the interface between the clients and the external component repository with the DDS environment.

(iii) The components repository who offers the possibility to download potentially any component type.

3.2 Mobile learning and business

- **SAMCCO**

The SAMCCO approach (Système d'Apprentissage Mobile Contextuel et Collaboratif dans des Situations Professionnelles) [12] aims to implement the technology of the contextual and collaborative mobile learning in professional situations, especially for learning the control of domestic, public or professional equipment in mobility situation.

The system proposed takes into account the requirements MOCOCO (Mobility, Contextualization, and Collaboration). It is designed to allow learners to learn the control of domestic, public and professional equipment based on contextualized learning resources. These resources will be used to produce learning units that can be exploited in the learning system.

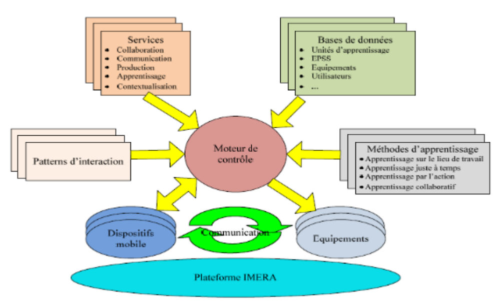


Fig. 3 The SAMCCO system architecture.

The entire system is based on the IMERA (Mobile Interaction in Real Augmented Environment) platform:

(i) The user performs its activities relating to the equipment in ERA (Environment Real Augmented).
(ii) The mobile device is properly configured for the learner.
(iii) The IMERA platform allows the communication of different levels between the mobile device and the equipment.
(iv) The interaction patterns contribute to the good design of the interaction interfaces.
(v) The services are generic services that support learning applications.
(vi) The databases store learning content, communication messages, etc.
(vii) The control engine organizes learning activities.

- **SAPA**

The SAPA system (Système d'Apprentissage Pervasif et Adaptatif) [27] is interested in the design of a learning system representing the employee's activities in a work environment.
The aim of this approach is to propose an adaptive and context-aware scenario model. It can create relevant content for a particular learner's need based on a particular work context. As the activities, can't be performed in the same way in all contexts, it is necessary to have an adaptive mechanism for selecting the best ways to achieve a task. The implemented scenarios can be articulated in different contexts in the workplace and provide a common structure of activities that guide learning at work.
To validate this approach, SAPA prototype has been implemented (see Figure 4). This prototype implements the scenario models designed during the system design. It is based on Service-Oriented Architecture (SOA) including web services and semantic web to facilitate sharing, reuse content and context-awareness.

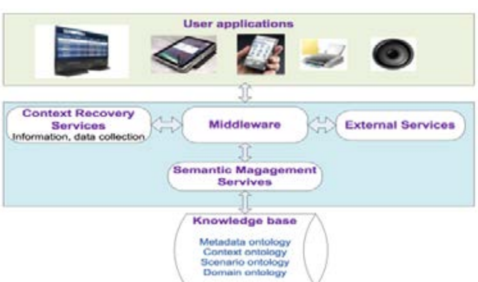


Fig. 4 The SAPA system modules organization.

(i) **Middleware**: Is a server that acts as a mediator in the service-oriented architecture. This module allows to aggregate and coordinates all services from other modules or environment.
(ii) **Context Recovery Services:** Is mainly in charge to discover or capture context data information such as environmental devices offering the services.
(iii) **External services:** Is a service container reserved for external services such as the services defined by providers about their products.
(iv) **Semantic Management Services:** Is deployed through a web services server to manage services at the semantic level. This module is a service container that can be invoked and implemented by other modules or applications of the system via the mediator (middleware) for information at the semantic level.
(v) **Application:** Defines the interactions between the user and the system. It can be presented by a simple shape such as a speaker that receives sounds sent by the system.

- **WoBaLearn**

The WoBaLearn system (Work-Based Learning) [41] is an approach that consists in the construction of hierarchical context model based on an ontology for the professional learning. It proposes a series of just-in-time activities for learning in the workplace.
To validate this system and to simplify the charge, reduce the cost and effort of maintaining and upgrading, the WoBaLearn system was implemented in a web server on a structure B/S (Browser and Server). The main logic of WoBaLearn system implementation on the server side, that the system interfaces can be achieved by mobile learners via the network and the mobile devices can collect context from user and multiple sensors, and transmit them to the system who uses its contextual information to make decisions to adapt the learning process.
The WoBaLearn system is implemented with three layers:

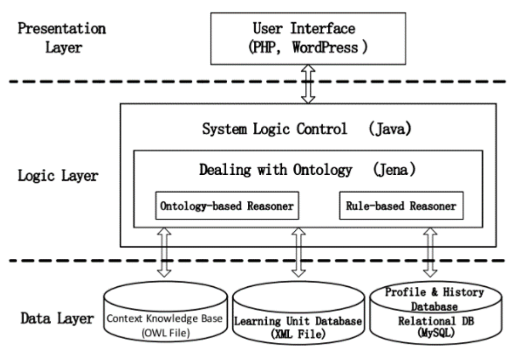


Fig. 5 The WoBaLearn Technical implementation.

(i) **Presentation Layer**: Provides services focused on the learner, such as providing learning tools for learner, and system interaction.
(ii) **Logic layer**: Receives information from the presentation layer and accesses to the data stored in the data layer.

(iii) **Data layer**: Provides access to data that are hosted within the system limits.

3.3 Mobile learning and education

- **CommonKADS**

The major disadvantage of mobile learning is the lack of a standard as well as the lack of awareness on how it may be well integrated into the learning process.
To respond to this problem, CommonKADS (Common Knowledge Analysis and Design System) [1] aims to formalize a comprehensive and generic model for mobile learning in order to understand its various components and also to guide future researchers in the mobile learning field, using knowledge engineering methodology. This work is the result of the Spirit - II (P5248) Peter-II project. It supports most aspects of KBS (Knowledge Based System), including project management, organizational analysis, knowledge acquisition, conceptual modeling, user interaction and systems integration.

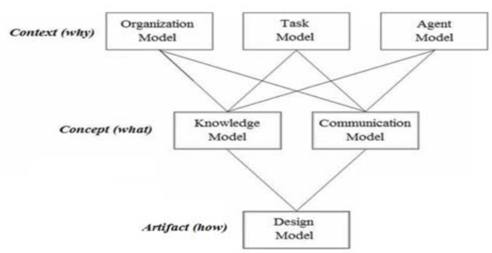


Fig. 6 The CommonKADS model.

(i) **Organization model**: Supports the analysis of the main characteristics of an organization to discover problems and the possibilities of knowledge systems and to determine their feasibility.
(ii) **Task model**: Analyzes the overall task layout, its inputs, and outputs, preconditions and performance criteria, in addition to its resources and skills.
(iii) **Agent model**: Agents are the executors of tasks. An agent can be a human, an information system, or any other entity that can execute a task.
(iv) **Knowledge model**: Is built to explain in detail the types and knowledge structures used to perform a task.
(v) **Communication model**: Represents the communication operations between agents involved in different tasks.
(vi) **Design model**: Provides the technical specifications of the system, based on the specific requirements.

- **CALM**

The CALM platform (ContextuAlized Learning through Mobility) [42] aims to instrument on a mobile device, the museum visits situations. The system considers two situations types: Free visit to the museum and school visit for educational purpose. In both cases, it is a question of adapting, in a transparent manner for the learner, the activities and the interactions suggested depending on his desires and his physical situations (location, work nearby, etc.).
To respond to these needs, this approach offers a process of the operationalization of the field and the context models using calculations of semantic proximity for learning activities generation. Thus, it defines a formalism of pedagogical rules offering two control modes: thematic and contextual control.
The approach has been validated by the presentation of a prototype made through a usage scenario. The mobile application that has been made is an Android application. It is with this latter that indeed the user interacts (see Figure 5). The calculations and contextual semantic proximities are achieved by a server application communicates with the client application via RESTlet services.

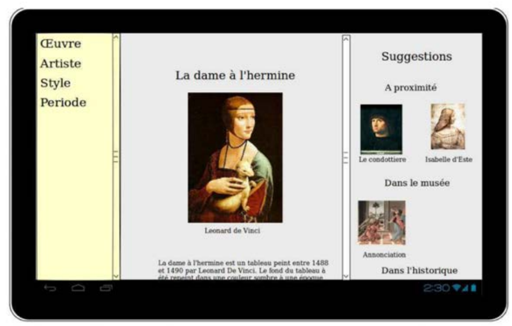


Fig. 7 Work consultation.

The user, having chosen the work on which he wishes additional information, is directed to a consultation screen of its description, this description is not automatically generated, it corresponds to what may be found in the exhibition catalog. At any time, the visitor can access to the self-assessment games, and as part of a free visit, these activities are aimed to offer an entertaining relaxation during the visit and allow the visitor to validate his knowledge.

- **MobileSIM**

Some physical concepts are difficult to understand by students, as is the case for the photoelectric effect, which is not often understood by college students.
The MobileSIM system [28] explores the mobile technologies potential for the improvement of the science learning and to consider, in particular, the contribution of a simulation of the photoelectric effect, using mobile devices and in cooperation situation for a better understanding of the quantum nature of light among the students at the college level. This approach was concretized by a mobile

learning platform MobileSIM which is developed for use by both subjects and professor (Fig. 8). It is accessible via the Internet and also in local mode with WiFi which is based on a complete architecture. It allows the teacher to enter the lists of his subjects, create groups, virtual labs, and activities, assign activities to subjects of particular groups, make the real-time tracking of who does what in the class and have access to the shares recording of each student during the simulation. This last function of the platform opens up very interesting perspectives for both, the research which is understanding the individual process of learning, and for the personalized assessment of each student.

3.4. Comparative study

Based on the context dimensions described in the second part of this paper and the in-depth study of the systems presented in this section, a comparison can be made between these systems according to the following table:

Table 1: Comparative table

	Professional			Transportation		Education		
	[12]	[27]	[41]	[40]	[26]	[1]	[42]	[28]
User	*	*	*			*		
Device		*				*		
Environment	*	*	*	*	*	*	*	
Activity	*	*	*					
Collaboration	*							*
Time		*						

According to this comparison, we can conclude that the use of context dimensions in a system varies according to its objectives and its needs. Therefore, the context modeling is a crucial phase in the contextual mobile learning system design.

4. Contribution

After studying different areas of application of mobile learning, we have chosen the work on the education field. Therefore, we propose an adaptation and personalization approach for mobile learning. It is based on a combination of the learner's learning style and its environment context, as location, movement, brightness, and proximity, and the device context as the display, connectivity, battery, etc. in order to provide the learner with the most appropriate course content format (Text, Presentation, Audio, and Video).

5. Conclusion and Perspectives

In this article, we have shown the fast-growing mobile learning interest while emphasizing the context-awareness concept. We presented the different areas in which mobile learning was used, including the professional, transportation and educational fields. According to this study, we can notice the gain provided by this use.

Indeed, the mobile learning in the professional world improves the performance and skills of the employees, in the transport sector, it provides services that facilitate the tasks and the drivers' activities. As for education, the M-learning is an evolution of traditional learning tools, it offers to the learners a contextual mobile learning environment appropriate to their needs.

Our main contribution is interested in the education field, and currently we are in the process of working on the modeling and implementation of our proposed approach.

References

[1] M. Mohanna, "Using Knowledge Engineering for Modeling Mobile Learning Systems," Université Laval, 2015.

[2] M. Droui, A. E. Hajjami, and K. Ahaji, "Apprentissage mobile ou mlearning: opportunités et défis," 2014.

[3] T. H. Brown, "The role of m-learning in the future of e-learning in Africa," in 21st ICDE World Conference. Retrieved from http://www. tml. tkk. fi/Opinnot, 2003, vol. 110.

[4] G. Vavoula and M. Sharples, "Meeting the challenges in evaluating mobile learning: a 3-level evaluation framework," Int. J. Mob. Blended Learn., vol. 1, pp. 54–75, 2009.

[5] F. Soualah-Alila, "CAMLearn: Une Architecture de Système de Recommandation Sémantique Sensible au Contexte. Application au Domaine du M-Learning.," Université de Bourgogne, 2015.

[6] M. Sharples, "How can we address the conflicts between personal informal learning and traditional classroom education," Big Issues Mob. Learn., pp. 21–24, 2006.

[7] N. Pinkwart, H. U. Hoppe, M. Milrad, and J. Perez, "Educational scenarios for cooperative use of Personal Digital Assistants," J. Comput. Assist. Learn., vol. 19, no. 3, pp. 383–391, 2003.

[8] C. Quinn, "mLearning: Mobile, wireless, in-your-pocket learning," LiNE Zine, vol. 2006, 2000.

[9] J. Traxler, "Mobile Learning: It's here but what is it," Interactions, vol. 9, no. 1, pp. 1–12, 2005.

[10] M. Sharples, I. Arnedillo-Sánchez, M. Milrad, and G. Vavoula, Mobile learning. Springer, 2009.

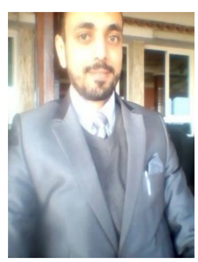
[11] C. O'Malley et al., "Guidelines for learning/teaching/tutoring in a mobile environment," 2005.

[12] C. Yin, "Samcco: un Système d'Apprentissage Mobile Contextuel et Collaboratif dans des Situations Professionnelles," Ecole Centrale de Lyon, 2010.

[13] G. D. Abowd, A. K. Dey, P. J. Brown, N. Davies, M. Smith, and P. Steggles, "Towards a better understanding of context and context-awareness," in Handheld and ubiquitous computing, 1999, pp. 304–307.

[14] A. K. Dey, “Providing architectural support for building context-aware applications,” Georgia Institute of Technology, 2000.
[15] T. Chaari, F. Laforest, and A. Flory, “Adaptation des applications au contexte en utilisant les services web,” in Proceedings of the 2nd French-speaking conference on Mobility and ubiquity computing, 2005, pp. 111–118.
[16] A. Syvanen, R. Beale, M. Sharples, M. Ahonen, and P. Lonsdale, “Supporting pervasive learning environments: adaptability and context awareness in mobile learning,” in IEEE International Workshop on Wireless and Mobile Technologies in Education, 2005. WMTE 2005., 2005, p. 3–pp.
[17] M. Weiser, “The computer for the 21st century,” Sci. Am., vol. 265, no. 3, pp. 94–104, 1991.
[18] B. N. Schilit and M. M. Theimer, “Disseminating active map information to mobile hosts,” Netw. IEEE, vol. 8, no. 5, pp. 22–32, 1994.
[19] R. Hull, P. Neaves, and J. Bedford-Roberts, “Towards situated computing,” in First International Symposium on Wearable Computers, 1997. Digest of Papers., 1997, pp. 146–153.
[20] N. Ryan, J. Pascoe, and D. Morse, Enhanced reality fieldwork: the context-aware archaeological assistant. Computer Applications and Quantitative Methods in Archaeology. V. Gaffney, M. van Leusen and S. Exxon, Editors. Oxford (UK), 1998.
[21] P. J. Brown, “Triggering information by context,” Pers. Technol., vol. 2, no. 1, pp. 18–27, 1998.
[22] H. E. Byun and K. Cheverst, “Utilizing context history to provide dynamic adaptations,” Appl. Artif. Intell., 2010.
[23] B. Schilit, N. Adams, and R. Want, “Context-aware computing applications,” in First Workshop on Mobile Computing Systems and Applications, 1994. WMCSA 1994., 1994, pp. 85–90.
[24] G. Chen, D. Kotz, and others, “A survey of context-aware mobile computing research,” Technical Report TR2000-381, Dept. of Computer Science, Dartmouth College, 2000.
[25] D. Petrelli, E. Not, C. Strapparava, O. Stock, and M. Zancanaro, “Modeling context is like taking pictures,” in Proc. of the Workshop” The What, Who, Where, When, Why and How of Context-Awareness” in CHI2000, 2000.
[26] M. Derntl and K. A. Hummel, “Modeling context-aware e-learning scenarios,” in Third IEEE International Conference on Pervasive Computing and Communications Workshops, 2005. PerCom 2005 Workshops., 2005, pp. 337–342.
[27] C. P. Nguyen, “Conception d’un système d’apprentissage et de travail pervasif et adaptatif fondé sur un modèle de scénario,” 2010.
[28] A. Soylu, P. De Causmaecker, and P. Desmet, “Context and adaptivity in context-aware pervasive computing environments,” in Symposia and Workshops on Ubiquitous, Autonomic and Trusted Computing, 2009. UIC-ATC’09. 2009, pp. 94–101.
[29] A. Sorvari et al., “Usability issues in utilizing context metadata in content management of mobile devices,” in Proceedings of the third Nordic conference on Human-computer interaction, 2004, pp. 357–363.
[30] P. Brusilovski, A. Kobsa, and W. Nejdl, The adaptive web: methods and strategies of web personalization, vol. 4321. Springer Science & Business Media, 2007.
[31] H. Godinet, J.-P. Moiraud, and L. France, “Scénarios de pédagogie embarquée: formalisation, réutilisation et essaimage,” Lyon Equipe ÉducTice INRP, 2007.
[32] P. Brézillon, “Task-realization models in contextual graphs,” in International and Interdisciplinary Conference on Modeling and Using Context, 2005, pp. 55–68.
[33] T. Strang and C. Linnhoff-Popien, “A context modeling survey,” in Workshop Proceedings, 2004.
[34] M. Baldauf, S. Dustdar, and F. Rosenberg, “A survey on context-aware systems,” Int. J. Ad Hoc Ubiquitous Comput., vol. 2, no. 4, pp. 263–277, 2007.
[35] B. Zhang, “Design and implementation of WoBaLearn-a work-based context-aware mobile learning system,” Ecole Centrale de Lyon, 2014.
[36] B. N. Schilit, M. M. Theimer, and B. B. Welch, “Customizing mobile applications,” in Proceedings USENIX Symposium on Mobile & Location-indendent Computing, 1993, vol. 9.
[37] K. A. M. épouse ABBAS, “Système d’Accès Personnalisé à l’Information: Application au Domaine Médical,” Institut national des sciences appliquées de Lyon, 2008.
[38] J. McCarthy and S. Buvac, “Formalizing context (expanded notes),” 1997.
[39] D. Popovici, “Gestion du contexte pour des applications mobiles dédiées aux transports,” Université de Valenciennes et du Hainaut-Cambresis, 2012.
[40] B. Zhang, C. Yin, B. David, Z. Xiong, and W. Niu, “Facilitating professionals’ work-based learning with context-aware mobile system,” Sci. Comput. Program.
[41] P.-Y. Gicquel and D. Lenne, “Proximités Sémantiques et Contextuelles pour l’Apprentissage Informel: Application à la Visite de Musée,” in Journée EIAH&IA 2013, 2013, p. 1.

Fatima Ezzahraa LOUHAB received the bachelor’s degree in systems and networks and the engineer’s degree in software engineering from the Hassan II University, Morocco, in 2012 and 2015 respectively. Currently, she is a Ph.D. student in faculty of Science Ben M’Sik, Morocco. She is a member of the Information Treatment Laboratory in the faculty of Science Ben M′Sik, Morocco.



Ayoub BAHNASSE Ph.D. on networks and telecommunication, received the master and the Ph.D. degrees in 2013 and 2017 respectively. Currently, he is a researcher associate on LTI laboratory, Software Engineering and Telecommunications Team at the faculty of Science Ben M’Sik. He is a reviewer on ELSEVIER journals. His research fields are: Security of networks, mobile learning, Wireless Sensor networks, QoS of networks, MPLS, IMS and NGN.

Mohamed TALEA received the Ph. D. degree in physics from Poitiers University, France, in 2001, he obtained a Doctorate of High Graduate Studies degree from the Hassan II University, Morocco, in 1994. Currently, he is a Professor in the department of physics at Hassan II University, Morocco, and he is the Director of Information Treatment Laboratory in the faculty of Science Ben M’Sik. He has published about 20 refereed journal and conference papers. His research interest covers Systems engineering, security of system information.