Semantic blended learning model based on the activity and situation for learning pervasive at work

Mamadou BAKOUAN[1], Tiemoman KONE[2] and Souleymane OUMTANAGA[3]

[1]Laboratory of Computer Science and Telecommunications, National Polytechnic Institute (INP-HB) Abidjan, 08 BP 475, Ivory Coast.

[2]Laboratory of Computer Science, Signals and Telecommunications - Research Institute of Mathematics (IRMA) 08 BP 2035 Abidjan 08, Ivory Coast.

[3]Laboratory of Computer Science and Telecommunications, National Polytechnic Institute (INP-HB) Abidjan, 08 BP 475, Ivory Coast.

Abstract

We present in this article an oriented blended learning model and activity status based on a script template and a contextual control model and proximity to account pervasive learning at work. It optimizes tasks execution process while relying on finding relevant information. Indeed, in the model of learning-oriented activity, the intention of the learner is clear, precise and the system knows what the learner wants to do and how. When No relevant activity is possible in the current situation, the situation oriented approach is triggered. Indeed, the learning-oriented model status provides recommendations to the learner according to the current status.

Keywords*: Pervasive learning, mobile learning, contextual scenario, learning by doing, semantic web, ontology.*

1. Introduction

Learning in the workplace is an ongoing process of acquiring knowledge and know-how within the company. This process consists of learning activities that can be summarized in three steps [5]. This is for the learner to learn in advance the tasks and upcoming activities, then master the problems and meet the requirements during the performance of work, and finally, learn about past activities and tasks in order to apply them to future work. This method of learning about the workplace improves the performance and quality of the company's activities.

Many studies found in the literature like those of [2], [1] propose models of learning-oriented activity. In this learning model, the intention of the learner is explicit and the system knows what the learner wants to do. But the model of learning-oriented activity according to [4] does not take into account the pervasive learning environment in the workplace. These studies show that a pervasive learning model only offers information, services, relevant to the current situation of the learner. However, we find that the existing models are based on oriented activity models that do not provide relevant information and do not take into account all the activities of learners because some activities are not known in advance. The main objective of this work is therefore to provide an oriented blended learning situation and business model based on a script template and a contextual control model and proximity to account for the pervasive learning environment at work. The oriented blended learning model activity and situation is based on a set of templates (Scenario Model, contextual control model, proximity control model). This model optimizes the process of execution of tasks at work and takes into account the context and the integration of blended learning activities based on the current state of the learner.

2. Pervasive workplace learning

Learning pervasive refers to the ability to find relevant information quickly in a specific context. This is to make learning in the work environment sensitive to the context by exploring the physical environment of the learner [7].

In this context, the dynamic adaptation and context-awareness are important elements in the pervasive learning activities in the workplace. These have resulted in the ability of a system to provide relevant learning resources based on the current state of the learner.

3. Literature Review

This section presents some research and studies on the characteristics of pervasive learning in order to show how these works have implemented their pervasive learning model.

The research of [1] falls within the context of pervasive learning in work situation based on activity. It offers a computerized personal assistant accompanying people on their workplace by

IJCSI International Journal of Computer Science Issues, Volume 13, Issue 1, January 2016
ISSN (Print): 1694-0814 | ISSN (Online): 1694-0784
www.IJCSI.org

providing assistance in their function and training.
However, the choice of technology does not allow greater flexibility in the services offered to the learning activities in the workplace. In addition, the current platform does not support the adaptation of applications based on context.
Researchers [4] are also interested in pervasive learning system at work focused on activity. They proposed a model of adaptive and contextual scenario for a pervasive learning system at work integrating a competency model and scenarios without breaking adaptation strategy. However, these contributions proposed some shortcomings that need to be improved:
The context Hierarchical Tasks Model and the context management model are not yet sufficiently detailed when it comes to interactions. It is necessary to refine this model to be able to explicitly describe the activities at the level of interaction and articulation between the two levels in a scenario to help treat a finer adaptation based on user interactions.
Learning oriented situation has been addressed in the work of [10]. They focused on instrumentation of informal learning in museum visits and taking into account the context in this type of situation. It offers a semantic model of the context following tour history, location and profile of the visitor. These spaces evolve according to the movements of visitors and their interactions with the device. The originality of this approach lies in its business model of the structure of context-specific knowledge in the field of museology using ontologies appendices following contextual spaces.
The limit of the model is related to the lack of formalization of the activity of the user in the museum visits situation.

The analysis of existing research shows that the explicit representation of scenarios modeling the activity and situation of the learner and the deep integration of the interactions in the design of scenarios is not always taken into account in these models. Indeed, the existing models do not take into account the activity-oriented and oriented blended learning situation. This makes the existing models less flexible and more difficult to change. In this context, we aim to propose a modular pervasive learning model based on scenario models. The scenario models describe the sequence of activities to acquire knowledge and expertise in the field to solve a particular problem in a specific context. The scenarios also help maintain overall coherence of activities and learning situations through different contexts.

4. Design methodology of blended learning model

This is a design methodology and modeling blended learning scenarios which is based on the scenario model. This methodology is to design scenarios blended learning models that represent the organization of activities and the quality of blended learning in the workplace. These scenario models are optimized by the addition of contextual control models and proximity to account for pervasive-environment.
The scenarios represent a way to organize and explicitly represent learning activities. As part of this work, the proposed scenario model to reflect the pervasive learning environment at work is based on a contextual Hierarchical Tasks Model. This model was developed in the work of [4], it is contextual, but insufficient to meet the needs of blended learning. Thus, this contextual Tasks Hierarchical Model is included and optimized to suit the needs for blended learning-oriented activity and situation. However, our blended learning model consists of a set of models: model scenario, contextual control model, proximity control model.

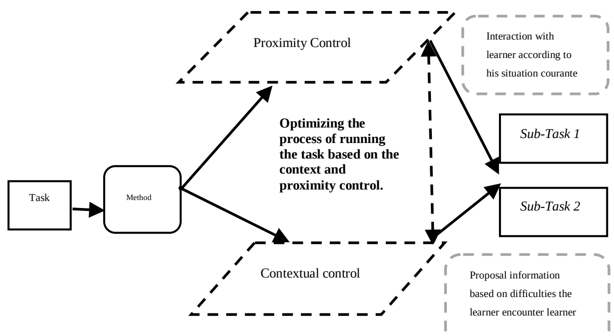

Fig. 1: Tasks Model Description Hierarchical Context Optimized.

An abstract task represents a higher level of complex activity which consists of sub-activities. A method describes how an abstract task can be realized.
Figure1 shows the performance of a task with the task and method paradigm."**Method**" describes a decomposition of the "**Task**" abstract into subtasks ("**Sub-task 1**," "**Sub-Task 2**") by the model of contextual control and proximity.

5. Graph of tasks decomposition and methods in the optimized contextual Hierarchical Tasks Model

doi:10.20943/IJCSI-201602-5763

The principle of the mechanism of task decomposition into sub-tasks describes the division of a complex task into simpler subtasks.

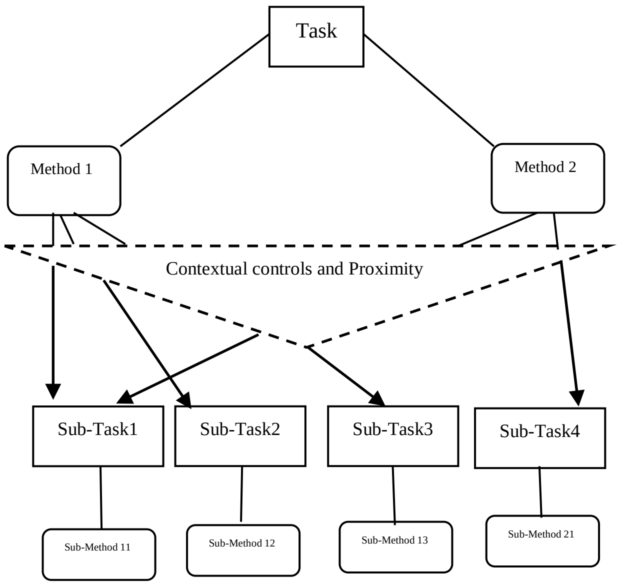

Fig. 2: Decomposition mechanism of a task subtask.

Figure 2 shows the decomposition mechanism of a "**Task**" into sub-tasks in two ways: the first is represented by"**Method 1**" that breaks down "**Task**" into three sub-tasks (**Sub-Task1**, Sub-**Task 2 and sub-Task3**), the second is represented by "**Method 2**" that breaks down the "**Task**" into two sub-tasks (**Task1 and Task4**). The order of execution of sub-tasks is specified by the contextual and proximity control defined in the two methods. Thus, both methods "**Method 1and Method 2**" are broken down into sub-methods to optimize the performance of tasks process. The task execution process is based on the search of relevant information.

In the next section, we will introduce the learning scenario model for the work that is actually an optimization of the conceptual Hierarchical Tasks Model for modeling learning scenarios at work.

6. Model of learning scenario at Work

Learning at work is to help workers immediately solve a problem encountered while working. Moussa is a new Customer Service technician from a company that sells tablets. He is responsible for the diagnosis, maintenance and reparation of tablets. In carrying out the tasks he has to change the front camera of a broken tablet. The change of a tablet front camera is for him an unknown task. He decided to learn this operation on site with his PDA while executing the task.

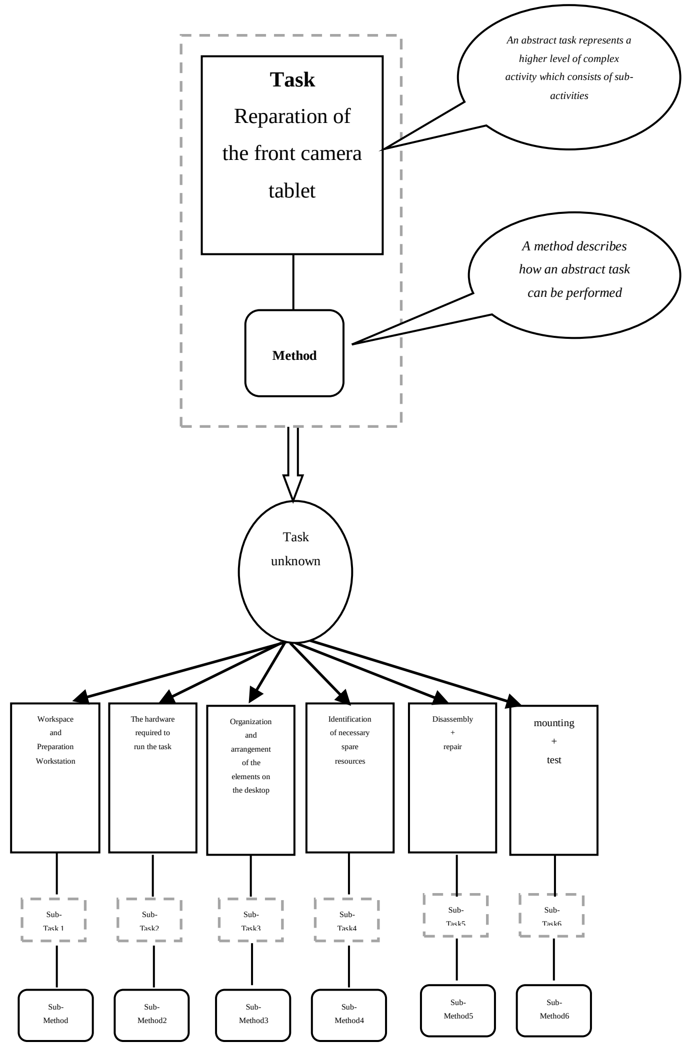

Fig. 3: Learning scenario model during work

Figure 3 show a learning scenario model during work that adds several learning methods to the main method. These methods have been tailored to different skill levels associated with learning to repair the camera of a tablet. These methods are designed for new technicians of after-sales service, which are responsible for the maintenance and repair of the tablets.

A "**Method**" that corresponds to an apprenticeship of two skill levels has to be added to the "**Task**".. The first level concerns the "**Sub-Tasks 1, 2 and 3**" and the second level concerns the "**Sub-Tasks 4, 5 and 6**". The "**Sub-Methods 1, 2 and 3**" are designed for a new technician who does not master this activity. It is for this technician to acquire basic skills. However, the "**Sub-Methods 4, 5 and 6**" are specified for a new technician who has been trained in the repair of a tablet camera before. But this is the first time he has to make this task at work. To optimize the process of implementation of tasks, it is necessary to integrate a control structure in the scenario model. This structure facilitates the interaction with the employee according to the current situation. This allows anticipating problems he might encounter and recommending relevant resources when performing tasks at work.

7. Contextual and proximity control

The purpose of context and proximity control is to propose specific activities for tasks at work. Indeed, the principle of the rules of context and proximity control is to propose a specific interaction based on learner's current situation.

This allows anticipating problems they may encounter and offers relevant information.

The context control and proximity is defined by three parameters: the criteria for selection of relevant resources, dependence between the aggregation criteria and finally the information on the proposed activity at the outbreak of the interactions.

However, the use of Choquet integral as aggregation operator can take into account the dependence of aggregation criteria [7].

An aggregation operator is a function $Agreg(x1 \ldots xn)$, $[0, 1]^n \rightarrow [0, 1]$ satisfying the following conditions :

– $\forall x \in [0, 1], Agreg(x \ldots x) = x$ (1)

– $Agreg(0 \ldots 0) = 0$ et $Agreg(1 \ldots 1) = 1$ (2)

– $x_k \leq y \Rightarrow Agreg(x_1 \ldots x_k \ldots x_n) \leq Agreg(x_1 \ldots y \ldots x_n)$

Aggregation operators are particularly used in multi criteria decision. A key point in multi criteria decision is to compare several solutions to a problem, each solution being defined by a set of satisfaction values in the range *[0, 1] N* following a set of criteria.

The satisfaction score of a solution S can then be expressed as: $\{x1. ..xn\}$ with each xi corresponding to the value of satisfaction for the criterion $i \in N$.

It is difficult to compare two vectors $[0, 1]^n$ between them to determine what the best solution is. Aggregations allow operators to overcome this difficulty by bringing a vector $[0, 1]^n$ to a real in *[0,1]*.

The best solution is then the one obtaining a "score" that is the closest to one.

We are interested in a particular aggregation operator: Choquet integral. The peculiarity of this operator is to take into account the interactions that may exist between the criteria. Several criteria can in fact be complementary, that is to say that the overall score for a satisfactory item on each of these requirements is greater than the sum of the scores of objects, each satisfying a criterion. Similarly, several criteria may be redundant, that is to say that satisfactory object on all of these criteria will have a score less than the sum of the scores of objects, each satisfying a criterion.

The basic idea of the Choquet integral as aggregation operator then is to involve not only weight to each aggregation criterion but also to each set of criteria aggregation. Consider that object *X*, such as a front camera, is represented by a set $N =\{1. ..n\}$ of criteria. These criteria take their values in *[0, 1]*.

Let be $\{X1. ..xn\}$ the values that these criteria can take for object *X*. The more satisfying is the criterion i, the more important will be *Xi*.

In our case, the criteria are the proximity established between *X* and another instance of the same concept of interest.

The Choquet integral is based on the concept of capacity. Capacity is defined as follows.

Let $N=\{1. ..n\}$ be the set of criteria. A capacity *N* conventionally denoted *v* is a function of all parts of criteria *P (N) to [0, 1]* with the following conditions:

$N (N) = 1$ (3)

$v(\emptyset) = 0$ (4)

$\forall i \in N, \forall T \subset P(N), v(T \cup i) \geq v(T)$

The aggregation operator Choquet, giving the "score" of the object *X* according to the values of *Xi* criteria is then calculated as follows [6]:

$$C_v(X) = \sum_{i=1}^{n} X(i) [v(Ai) - v(Ai+1)] \quad (5)$$

With (.)A permutation of *N* such that $X(1) \leq X(2) \leq \ldots \leq X(n)$,

$$Ai = \{(i) \ldots (n)\} \quad (6)$$

And $An+1 = 0$ (7)

To take into account the unpredictable context and the recommendation of the relevant information, we consider that the solutions are compared according to two criteria, the *time* criterion and the *current situation* of the learner criterion. Thus, the more an unpredictable context has an important score on a criterion the more it is appropriate to recommend it to the learner. The following table shows three contexts(*x*, *y*, *z*) for the recommendation and their relevance score following both criteria. These relevance scores correspond to the proximity of the solution considered by the learner and the solution to recommend

Table 1: Criteria for comparison of a recommendation

Criterion/ Unpredictable Background	*x*	*y*	*z*
*Execution time of the task "**Time**"*	0.4	0	1
*The current situation of the learner "**Situation**"*	0.4	1	0

To determine the score of an object following the Choquet integral, we must determine: $v(Time, Situation)$, $v(Time)$ and $v(Situation)$.

Scores of unpredictable contexts x, y and z are checked by $Cv(X) > Cv(Y)$ et $Cv(Y) = Cv(Z)$. By definition of capacity we have directly $v(Time, Situation) = 1$, we just have to determine the score of the two other criteria. This is given the same score to the items y and z which is translated by $v(Time) = v(Situation)$. Moreover, this score should be low enough to keep inequality $Cv(X) > Cv(Y)$. We can then choose $v(Time) = 0.3$.

We then easily verify that the proposed order is modeled by a Choquet integral on v:

$Cv(X) = Cv(0.4, 0.4)$ (8)

$= 0.4\,(v(Time, Situation) - v(Time)) + 0.4 \cdot v(Time)$ (9)

$= 0.4\,(1 - 0.3) + 0.3 \times 0.4$ (10)

$= 0.4$ (11)

$Cv(Y) = Cv(0, 1)$ (12)

$= 0 \cdot (v(Time, Situation) - v(Situation)) + 1 \cdot (v(Situation))$ (13)

$= 0.3$ (14)

We directly get $Cv(Y) = Cv(Z)$ by symmetry. (15)

8. Oriented blended learning model activity and situation

We offer a blended learning model oriented activity and situation based on a script template and a contextual control model and proximity to account for pervasive learning at work.

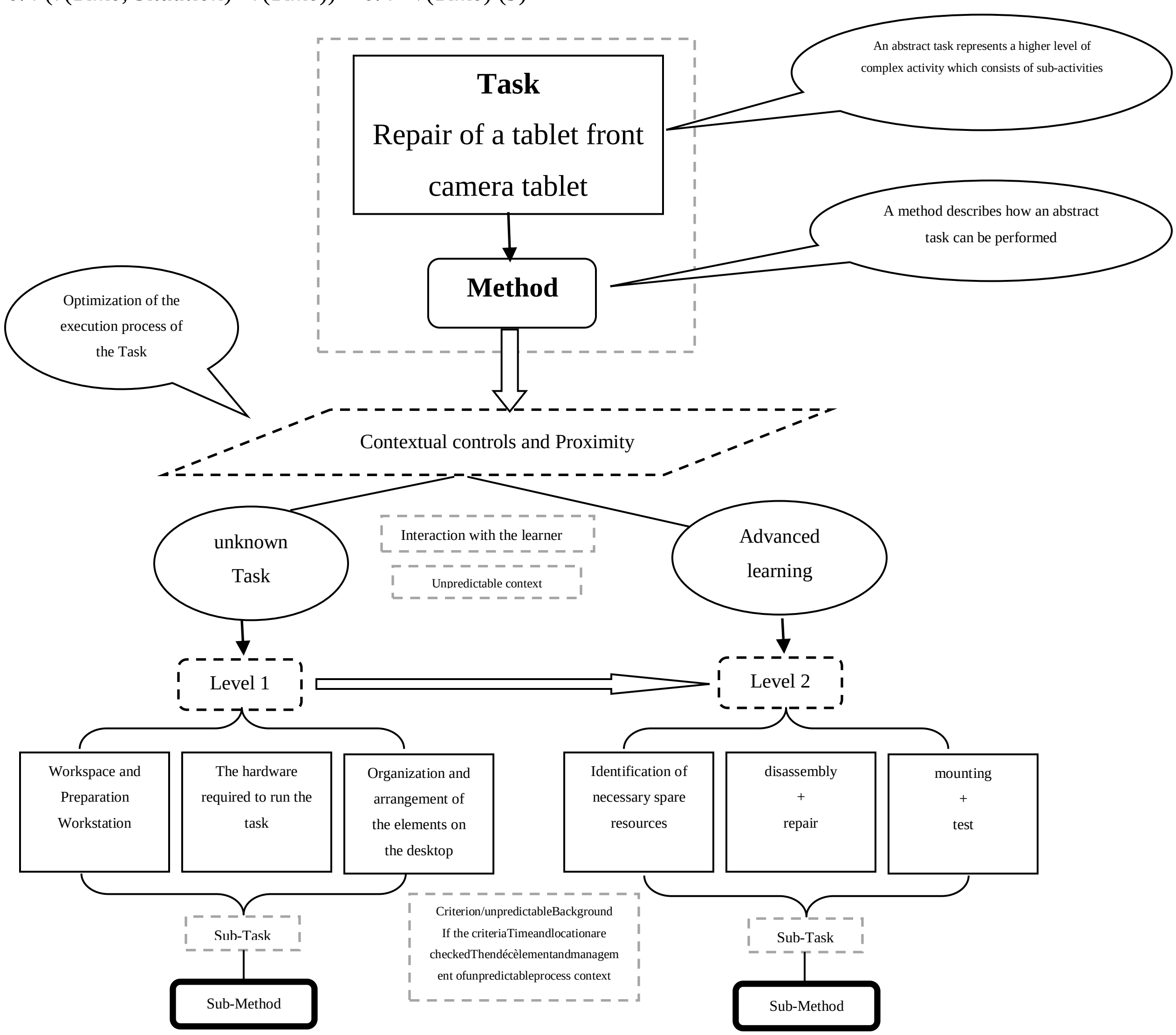

Fig. 4: Blended learning model oriented activity and situation at work

Figure 4 shows a flexible model of blended learning in the workplace. This model incorporates a control structure that takes into account a pervasive learning environment in the workplace. This is to optimize the process of tasks implementation in the workplace by providing relevant information based on learner's situation. The Joint Learning model also allows managing the unpredictable context. The structure of contextual and proximity control is checked by *time* and *situation criteria*. *Time* criterion is the execution time of a task in the workplace and *situation* criteria represents the current state of the learner.

9. Deployment architecture blended learning model

The blended learning model must be implemented in an appropriate architecture that is flexible enough to provide relevant resources based on the current situation of the learner.

Furthermore, the blended learning model has to face the dynamic and unpredictable changes in the environment while ensuring the reuse of resources. However, the architecture of the Semantic Web provides a separate specification of these resources. Indeed, the semantic web provides a set of standard tools and ontologies that formalize different models at the semantic level.

SOA (Service Oriented Architecture) allows to design an architecture that facilitates investigation, detection and exploration of the environment through services to dynamically build models of the environment.

This increases the interoperability, reuse of features and all devices and technologies that implement their functionality through web services [3].

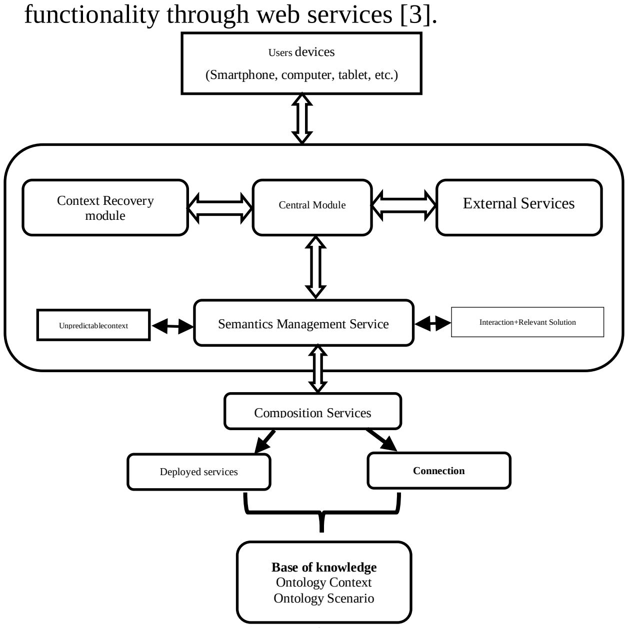

Fig. 5: Deployment architecture of the blended learning model

Oriented Architecture approach facilitates the deployment of a blended learning environment based on the aggregation and orchestration of services required for an organization.

The "Central module" is a server that can aggregate and coordinate all services from other modules. He can communicate with web services using SOAP (services at the semantic level: Simple Object Access Protocol).

The "Context of Recovery Module" is in charge to discover or capture context data information such as environmental devices offering the services. It also supports the detection of capabilities of services and new services.

The "External Services Management Module" is a service container reserved for external services, which communicate with the system via the SOAP protocol.

The "Module Semantics Management" allows you to manage services at the semantic level. These are services scenario ontologies and context. It communicates with other modules via the SOAP protocol. At the semantic level, this module can also manage the unpredictable context, the interaction with learners and the recommendation of appropriate solutions according to learner's current situation.

The "Module Semantics Management" is developed in three parts: the part of the interface is represented by a "Services Deployed" component that contains the service interface, the service body is represented by the component "Composition services "that contains the code to perform the services. The use of ontologies for context modeling in pervasive learning models has been the subject of several researches [8], [11] and [9]. The third part is the "Connection" component that contains the service to connect to the knowledge base, to send requests and orders regarding the scenario and context ontologies.

10. Conclusion

We presented a semantic blended learning activity and position-oriented model based on a script template and a contextual control and proximity model to account for pervasive learning at work. The use of semantic actions, contextual and proximity controls on this blended learning model allows to optimize the process of tasks execution while relying on finding relevant information.

The originality of this approach lies on our context and proximity control model that allows the interaction and anticipation of difficulties the learner may encounter while performing a work task. In addition, this approach allows us to offer appropriate solutions based on the learner's situation in order to facilitate the rapid and efficient execution of a given task.

References

[1] Benjamin Barbry, Thomas Vantroys, Alain Derycke : *Support à l'apprentissage pervasif in situ*
Laboratoire d'Informatique Fondamentale de Lille
Université des Sciences et Technologies de Lille 59655 Villeneuve d'Ascq Cedex –France 2008

[2] Caron Pierre André[1], Xavier Le Pallec[2], Sarra Kaddouci[2], François Julien Ritaine[2]*Expérimentations d'apprentissage pervasif, juste à temps, en situation de travail*(2008).
[1] laboratoire Trigone, CUEEP, Université des Sciences et Technologies de Lille1
[2] laboratoire LIFL, Université des Sciences et Technologies de Lille1

[3] Cuong Pham-Nguyen, Serge Garlatti, Simon Boung-Yew Lau, Benjamin Barbry, Thomas Vantroys (2009):
An Adaptive and Context-Aware Scenario Model Based on a Web Service Architecture for Pervasive Learning Systems. IJMBL 1(3): 41-69 - 2009

[4] Cuong pham nguyen *et* Serge Garlatti**.**École nationale supérieure des télécommunications de Bretagne
Conception d'un système d'apprentissage et de travail pervasif et adaptatif fondé sur un modèle de scénario
4èmes journées Francophones Mobilité et Ubiquité, 28-30 mai, Saint Malo, France, New York, NY : ACM, 2008, pp. 65-72.

[5] David, B., Yin, C., & Chalon, R. *Contextual Mobile Learning Strongly Related to Industrial Activities: Principles and Case Study.* Paper presented at the The International Conference on E-Learning in the Workplace (ICELW 2009), Teachers College at Columbia University, New York, USA.

[6] Detyniecki, M. *Fundamentals on aggregation operators Technical report University of California Berkeley*.
Doctoral thesis - research report 2001-002, Laboratoire d'Informatique de Paris 6, 2000.

[7] Ghim, S.-J., Yoon, Y.-I., & Ra, I. *A Context-Adaptive Model for Mobile LearningApplications*. In Web Information
Systems – WISE 2004 Workshops (Vol. Volume3307/2004, pp. 102-113): Springer Berlin / Heidelberg.

[8] Hong, M.-w., & Cho, D.-j. *Ontology Context Model for Context-Aware Learning Service in Ubiquitous Learning Environments*. International Journal of Computers (2008*)*, 2(3), 193-200.

[9] Krummenacher, R., & Strang, T. *Ontology-Based Context Modeling*. Paper presented at the In Workshop on Context-Aware Proactive Systems (2007).

[10] Pierre-Yves Gicquel, Dominique Lenne. *Sémantique et contexte en mobilité Opérationnalisation d'un modèle sémantique du contexte pour l'apprentissage en mobilité*. 23es Journées Francophones d'Ingénierie des Connaissances IC 2012, Jun 2012, Paris, France. 2012, IC 2012.

[11] Yu, Z., Zhou, X., & Nakamura, Y. *Semantic Learning Space: An Infrastructure for Context-Aware Ubiquitous Learning*. Paper presented at the 5th international conference on Ubiquitous Intelligence and Computing, Oslo, Norway, (2008) 131 - 142.

Mamadou BAKOUAN is a Ph-D student in Mathematics and Information Technologies (EDP-INPHB Yamoussoukro, Ivory Coast).Responsible for the management of web services Data center RITER at the University of Félix Houphouët-Boigny of Cocody. Assigned to the Research Institute of Mathematics (IRMA) hosting the Data center of RITER.

Tiemoman KONE is a Director of the Technological and Scientific Information in the Ministry of Higher Education and Scientific Research, Director of IRMA (Institute of Mathematics Research) PCA WACREN (West and Central African Research and Education Network). Deputy Coordinator of RITER (Ivorian Telecommunications Network for Education and Research)

Souleymane OUMTANAGA is a Professor at the National Polytechnic Institute Felix Houphouët-Boigny. He is also a member of the LARIT, serves as the Director of Strategic Partnerships at APTLD, and represents the African region in the ccNSO council.