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Bridging the Gap between Competency Based Approach and Intelligent Tutoring Systems

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Abstract

The Competency Based Approach (CBA) represents a real opportunity for the development of higher education in Morocco, combined with the advantages of Intelligent Tutoring Systems (ITS), this approach could well solve many problems, particularly the inadequacy between school teaching and labor market needs, the professional achievements enhancing, overcrowded classrooms, etc.

Convinced by the undeniable contribution of technology to all teaching methods and based on our experience of CBA adoption, we propose an ontology and a conceptual technological architecture to allow the CBA to take benefit from the technological advances of ITS. To justify the interest of designing a new ITS architecture supporting the CBA, we will highlight the changes resulting from CBA adoption, in understanding, reasoning and competency modeling, also in learner modeling, learner pathway management and pedagogical engineering.

Keywords: Competency Based Approach, Intelligent Tutoring System, Modeling, Ontology.

INTRODUCTION

As part of our research on ITS, e-learning, education systems and information systems modeling, we have been interested in the various problems currently facing higher education in Morocco. We have devoted ourselves, inter alia, to study the Competency-Based Approach (CBA) and the horizons that could be opened up by its adoption; Including the enrichment of teaching practices at the university, the professionalization of training, the adaptation of teaching strategy to the socio-economic environment, etc. We have already explored several paths to find an appropriate solution to some important aspects of the problem regarding the approach used, particularly in higher education. In this paper, we are particularly interested in introducing ITS technologies into CBA practices [1]. We have set ourselves an intermediate goal of designing a theoretical model to study this approach in depth to facilitate its interoperability with existing platforms and to provide an overall theoretical framework that will guide our future actions, for the detailed study and implementation of some problematic modules of CBA, also for the experimentation of other modules in progress.

In the rest of the paper, we will introduce the CBA then we will introduce our ontology and we will also present briefly our experience of CBA adoption and our efforts to implement technology into the practice of this approach. Finally, we will propose a global model of conceptual architecture allowing the introduction of technology into CBA practices and the interoperability with ITS platforms.

COMPETENCY BASED APPROACH

A. The state of art analysis

At the beginning of the 20th century, linguists defined the concept of competency and distinguished it from the concept of performance. Psychologists of cognitive development accept the distinction between competency and performance, but note a discrepancy between the prescriptive competency (which is defined a priori) and the effective competency of the subject in action (which is actually observed).

In the last two decades, scientists have also developed their approach to the concept of competency. Before that, they were talking about qualification, which is a prescriptive concept, defined a priori. Competency becomes the capacity of an individual to manage his or her potential in a situation, it is defined in reference to the action of the subject in situation. The context is therefore considered. Jonnaert gives definitions of the concept of competency in various fields between 1988 and 2000 to show the evolution of the concept before being adopted in education in 2002 using the following definition: “A competency refers to a combination of elements that the subject can mobilize to successfully handle a situation” [2].

There are many definitions of the concept of competency in the educational sciences fields. But there is some consensus: Competency is a know-how that integrates ability and

knowledge, it is complex, it refers to cognitive, affective, social or psychomotor skills and it is specific to a set of situations [3].

From the analysis of contemporary literature, it emerged three constant elements that constitute the concept of competency:

- A competency would be based on the mobilization and coordination of a variety of resources by a person, in a given situation, specific to the person, specific to the situation and / or to the context;
- A competency would only develop in a situation;
- A competency would be acquired only when the treatment of the situation is completed.

The major element that emerges from the analysis of all definitions mentioned is the establishment of a competency in a category of situations and a context that give it a meaning.

Two concepts are recurring in the definitions analyzed:

- the concept of *situation*
- the concept of *resource*.

The idea that handling of the situation must be completed to qualify as competency returns in nearly all the definitions. In this case, the definition adopted here relating to the competency of a person in a situation is this: « *Competency is the implementation by a person, in a situation and in a given context, of a diverse and coordinated mix of resources. This implementation is based on the choice, mobilization and organization of these resources and on the relevant actions taken to successfully deal with this situation* » [4].

CBA is a pedagogical tendency of considering competency-based learning. It provides a fresh view to learning and teaching. The challenge now is to enable learners to build competencies, that is, to provide them with a framework for developing competencies. Roegiers justifies the fundamental role of the CBA by presenting three challenges that it should address [5]:

- The proliferation of knowledge, which invalidates all pedagogy based solely on the transmission of knowledge;
- The increasingly recognized need to provide students with meaningful learning leading to authentic applications;
- Combating school drop-out.

A competency cannot be taught. We can teach only knowledge, which is resource. Even then, it would be better for these knowledges to be taught in reference to the problems they deal with, in context, rather than in a "text of knowledge" entirely detached from its uses.

In a competency-based approach, there are essentially two moments in learning:

- *The punctual learning of resources:* knowledge, know-how and know-how-to-be according to the teaching methods,
- *Integration and formative evaluation activities*, designed to teach the student to mobilize resources in complex situations.

This approach offers a richer framework than the objective based approach. Indeed, with competency, we know what a person knows and the level of mastering this knowledge in a contextual use [6].

The most frequently cited limitations of this approach are the resources needed (learning and assessment situations), and changes in teacher practices, but also significant lack of implementation process of The CBA and the theoretical instability of the concept of competency [7].

This profusion of definitions does not seem to facilitate the implementation of this approach, especially as they are expressed through words which can be subject to many interpretations that may gave rise to significant ambiguities. Indeed, it is impossible to speak of pedagogy involving the competency based approach without all the participants in the different teaching-learning processes understand clearly this concept as well as its pedagogical approaches.

It is therefore necessary to make explicit all the implicit practices and to clarify all the ambiguities around the concept "Competency" [8-9]. Hence the need for a formalism that will facilitate the implementation of this approach.

B. The CBA What difference does it make?

In order to design an adequate architecture that will support the CBA, we propose to study the contrast between this approach and the approaches based on content acquisition. This would allow us to prove the benefit of proposing a new platform and to identify the aspects on which we will focus more.

Here is a synthesis of many reflections of Lasnier [4], Roegiers [5], Chauvigné & Coulet [10], Perrenoud [11], Boutin [12], Tardif [13] and Jonnaert [7], which summarizes the differences between the Approach focusing on competencies acquisition and the Approaches focusing on the content (knowledge) acquisition**.**

What difference does it make for the training program? (table 1)

Table1: Training program

Approach focusing on competencies acquisition	Approach focusing on the content acquisition
• The courses and basic contents selection is made according to the competencies to be acquired. • Professional situations are used as a basis to the choice of content. • The emphasis is on the acquisition of specific competencies among students.	• The courses and basic contents selection is made according to the disciplines taught. • Disciplinary knowledge is used only to select content. • The emphasis is on the acquisition of disciplinary knowledge.

What difference does it make for the teacher's role? (table 2)

Table 2: Teacher's role

Approach focusing on competencies acquisition	Approach focusing on the content acquisition
• The teacher is a facilitator of learning focused on: • Learning process • The content planning according to the competency to be acquired • The organization of an environment that facilitates learning • Assessment of the achievement of competency	• The teacher is a content expert focused on: • Content coverage • The course planning according to the content acquisition • The organization of teaching • The knowledge assessment

***What difference does it make for the student's role*?** (table 3)

Table 3: Student's role

Approach focusing on competencies acquisition	Approach focusing on the content acquisition
The Student is seen as: • Having prior knowledge and experience that impact on learning. • Being active in the learning process • Responsible of taking charge of his or her learning.	• Student's prior knowledge and experience are not considered in learning • The student is rather passive, listening. • The student depends on the teacher for his or her learning.

***What difference does it make for the learning assessment*?** (table 4)

Table 4: Learning assessment

Approach focusing on competencies acquisition	Approach focusing on the content acquisition
• Assessment focused on achieving competencies based on expected performance and behaviors. • Frequent use of formative evaluation to support the acquisition of competencies. • Assessment is part of learning.	• Evaluation focused on acquiring knowledge. • Little or no use of formative evaluation. • The evaluation is done at the end of the learning in order to classify students.

What difference does it make for the learning? (table 5)

Table 5: Learning

Approach focusing on competencies acquisition	Approach focusing on the content acquisition
• Knowledge is built as the competency is acquired. • Competency is acquired in a global way and not in a piecemeal way. Students are placed in a situation (context) where competency will be demonstrated, less complex at the beginning and more complex at the end of the competency acquisition. • Knowledge is closely associated with the competency and with its implementation context, which makes it meaningful for learning. • Competency is perceived as a system and does not exist outside the contexts in which it is used. • Application and transfer of learning begin in the classroom. • The acquisition of competency is made following several applications to different contexts. • Students are placed in the most authentic possible situation to acquire competency. They have to use their knowledge and the situation data to demonstrate competency.	• The acquisition of knowledge should be carried out before the development of competency. • The acquisition of knowledge is fragmented by going from simple knowledge to complex knowledge. • Knowledge is presented outside of any context. It often makes little sense to the students. • A student may theoretically talk about a test, but this fails to ensure the ability to use his knowledge to act in a real situation or to resolve a problem. • Application and transfer of learning are delayed. • Competency is considered as the association by the student of several knowledge in situations. • The knowledge is decontextualized and acquired either by memorization or through simple exercises of recall as taught by teacher. There is no processing of knowledge by the student.

The CBA is better suited to preparing learners for the labor market

Chauvigné & Coulet [10] think that the CBA contributes to a better professionalization of the students benefiting from this approach, to demonstrate this, we present a table (*Table 6*) that shows the contrasts between the labor field and the traditional teaching exclusively based on content (knowledge) transmission [14].

Table 6: The labor field and Traditional teaching

Traditional teaching	Labor field
• Just providing facts to learners • Individual effort requested • The aim is to obtain a diploma or full degree • Fixed courses • Receiving information • Knowledge acquired is outside its context	• Problem solving • Working in teams • Learning how to learn • Continual improvement • Competencies and interdisciplinary knowledge • Contextual knowledge

In contrast to the knowledge-based approach, the Diagram Description of the competency development process over time (Figure 1) shows that the relationship with learning, building and development of competencies does not end after leaving school, in fact it is continues throughout the individual's professional life.

Four phases seem to characterize the process of building a competency, from the activities of the person in situation, to the generalization of the competency [15].

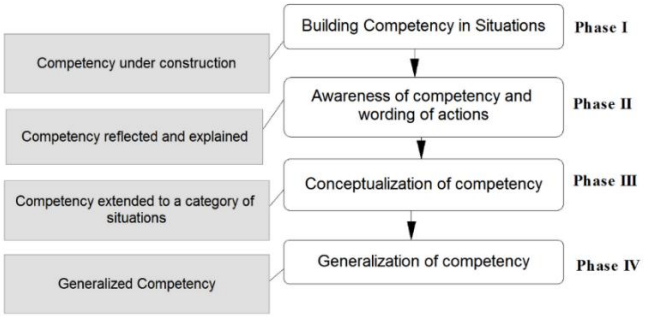

Figure 1: Activity Diagram for Description of the competencies development process over time

The short time devoted to build a competency at school, is limited to Phases I and II of Figure 1. The stagnation of a competency in short time (Phases I and II), does not allow, whether in basic education or in higher education, to actually build competencies during this short time period at school.

A close relationship between practice environments and academic training is essential to enable the participants in the training to reach Phases III and IV of Figure 1. Taking into account the long time required to build a competency is crucial. Finally, a competency is never completed, the viability of situations is always called into question. This particular dynamic of competencies that also places people in a lifelong learning perspective.

The CBA is complementary to content-based approaches

Adopting a CBA does not mean « turn its back » on the content-based approach. The idea is to give new strength to knowledge; linking it to social practices, complex situations, problems and projects. With the competency based approach, we will not abandon the knowledge. In some ways, knowledge (content) is the main ingredient to build competencies [16].

MODELING THE COMPETENCY BASED APPROACH CONCEPTS (CBA)

The need for an ontology of competency

An ontology is a representation of general properties of what exists in a formalism that supports a rational treatment. This is the result of an exhaustive and rigorous formulation of the conceptualization of a domain [17]. The introduction of an ontology in an information system and particularly in ITS, aims to reduce or even eliminate the conceptual and terminological confusion and ensure a shared understanding to improve communication, sharing, interoperability and reusability [18].

In recent years, many ontologies have been proposed for the description of competencies and their relationships [19-20-21-22-23-24-25-26]. However, all these ontologies focus on the concept of competency and its attributes without relating it to the concepts of “Knowledge”, “Resources”, “Situation"” and the “Context” of competency practice.

Construction of the CBA ontology

After extensive study of the CBA and its constraints for the adoption and the implementation as well as the constraints presented by the Moroccan educational system. As a first step towards a comprehensive solution to the problems of adoption of the CBA we thought of formalizing this approach. To do this we opted for the building a domain ontology, which we believe is the appropriate solution to reduce or eliminate the conceptual and terminological confusion and ensure a shared understanding in order to improve communication, sharing, interoperability and possible reuses.

To build our domain ontology, we first proceeded to the identification of conceptual primitives (concepts and relations) and semantics of the domain (conceptual properties of primitives) in a corpus of knowledge. Secondly, we have structured and formalized the conceptual description. The corpus that we have analyzed is a set of documents expressed in natural language, and therefore is informal. This corpus covers the whole field of knowledge about the CBA, to help remove any semantic ambiguities. Specific knowledge of the field has been identified in terms of conceptual primitives and axioms.

Our ontology is a hierarchical organization of concepts and relations that we have emerged from the formal analysis of literature of CBA and pedagogies that have been developed around this approach, particularly the pedagogy of integration [5].

The concepts of our ontology (Figure 2):

A ***situation*** (or a class of situations) is *emblematic*, it presents *problems* to solve, *challenges* to rise, *constraints* to overcome, it belongs to a *domain* of life or a scientific *discipline*, it raises *questions* that must be answered and aims at one or several *purposes* to achieve. A situation may be, in terms of teaching, divided into *tasks* with a degree of *complexity, processes* to execute and *products*. A situation has a *context* that can be *real* with all its complexity or it can be *didactic* for learning (or target) i.e. a simple scope of practice or integration of a competence. The situation has *assessment tools* which defines the means and *criteria* of evaluating the performance under the circumstances of the situation and its context.

The main Classes of resources mobilized in a situation:

- *External resources* are often environmental resources needed to develop the competency (human resources, spatiotemporal and material resources, contextual resources, social resources, cultural resources, didactic resources, help, …)
- *Internal resources* belong to the individual (competencies, cognitive resources, conative resources (experiences), physical and mental skills, …)

Knowledge is a particular resource mobilized by the competencies in a situational problem. It is important to deepen the knowledge-competencies links. It is not enough that a knowledge is "vaguely" connected to a competency, its mobilization must be attested [6].

In a didactic context, it is essential to define the knowledge needed to solve a situational problem, in order to enable the learner to acquire this knowledge before mobilizing it in a given situation.

A situational problem is the opportunity for practice, learning and assessment competencies, it is the key resource of teaching according to CBA. Indeed, a competency is always associated

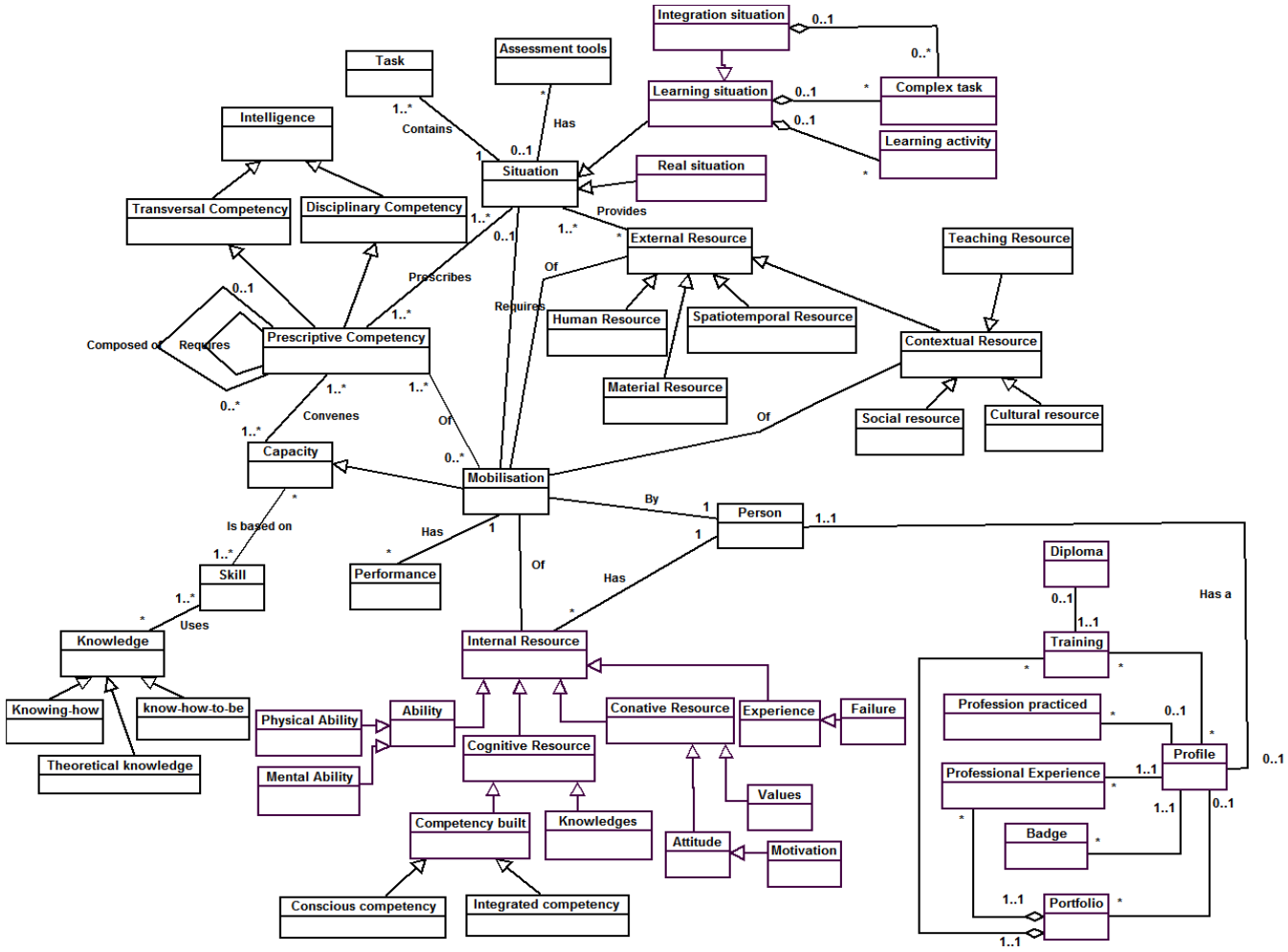

Figure 2: The CBA Ontology overview

at least with a situation or with a class of situations. A competency is developed in situations and it is the result of completed, successful and socially accepted handling of these situations by a person or a group of people in a given context [3].

A situation is emblematic, it presents problems to solve, challenges to rise, constraints to overcome, it belongs to a domain of life or a scientific discipline, it raises questions that must be answered and aims at one or several purposes to achieve. A situation may be, in terms of teaching, divided into tasks with a degree of complexity, processes to execute and products. A situation has a context that can be real with all its complexity or it can be didactic for learning (or target) i.e. a simple scope of practice or integration of a competency. The situation has assessment tools which defines the means and criteria of evaluating the performance under the circumstances of the situation and its context.

The *mobilization* is more than a routine application or use; it is a meta-cognitive *capacity* of *identification*, *selection*, *activation*, *coordination* and *integration* of various resources to deal with situations. This is the central concept of our ontology; it combines the situation, the competences, the person, the performance and all kinds of resources.

The Resources effectively mobilized in a situation, far exceed, those determined in the prescriptive competences that are required for the resolution of the situation. Indeed they are of different nature and from various sources; internal resources of the person (with a complex profile) which may be integrated competences (implicit, innate), conscious competences (acquired, explicit, conscious, transferable, conceptualisable) or cognitive (knowledge embodied by the person) or life experiences or integrated competence (implicit, innate) or aptitudes (body and mental predisposition), external resources of the situation may be material (tools that extend the perception and action of the person), spatiotemporal (the time and the space given, the opportunity) or human (support, aid, assistance, monitoring) and contextual resources may be social (prejudices, ethic) or cultural (religious prejudices, patrimony, shared memory).

Prescriptive (or required) competence is a simple pre-supposed cutting of effective competence that should take place, it is conceived as an organizational framework of the curriculum,

according to the cascade architecture of Jonnaert [3]. Transversal (or extended) competence is a common competence to several disciplines. Disciplinary (or specific) competence is a competence associated with a specialty domain.

Competence is the result of an efficient coordination of the capacities of the person with all the categories of resources. Capacity is the unit, on which prescriptive competence is based. It is a meta-cognitive structure stabilized, operative and reproducible as the scheme.

The skill is a meta-cognitive, internal and conscious process of the person; it is specific to a class of tasks or specific situations and it is based on well-defined contents.

The contents may have different forms: “Theoretical knowledge” which is conceptual, declarative, factual and codified in books or “Knowing-how” which is operative and procedural or “Knowing-how-be” which is behavioural and relational.

Bruner [27] considers in that the speech on competence as a speech on the intelligence. This intelligence takes several forms according to Gardner [28]:

These "intelligences" are: linguistic and logical-mathematical (the styles of thinking measured most often on psychological tests), musical, spatial, bodily-kinesthetic (including large and small motor skills), interpersonal (an area of strength for teachers, social workers, and politicians), and intrapersonal (self-knowledge). These “intelligences” represent absolute (or maximum) competences.

Our ontology does not present the concept of effective (or real) competence, this competence cannot be formalized nor represented, because it is the work (or the performance) of the actor in the situation that is taking place in time, that is the person builds in the context of the situation. The prescriptive competence is supposed to be the decontextualised representation of effective competence.

After the construction of the ontology, the obtaining and the maintaining of a consensus on the choices of representation and conceptualization made in this ontology, it is time we tackled the stage of operationalization and prepared the implementation.

OUR IMPLEMENTATION PROCESS OF CBA

The High Schools of Technology (HST) in Morocco are vocationally-oriented institutes, they prepare technicians who will take part in the labor market, they are therefore supposed to provide profiles that are employable and directly operational. To that end, they have always devoted a large part of their curricula to practical training and to work placements. However, there are still large disparities between the profiles formed and the labor market demand, market demands are constantly changing and the competency profiles required are changing, but universities do not necessarily follow the changes and appear to operate outside the economy.

It is important to recognize the need to move towards a pedagogy that will promote employability and integration into the labor market. identifies three factors in the competency-based approach adoption: "response to the labor market changes", " more attention paid to work skills and employability " and " a new concept for communication with employers ".

Despite the growing interest and international enthusiasm for this approach, it has not yet found its place in higher education in Morocco. The Fez High School of Technology, therefore, undertook a pilot experiment in Morocco, it set itself the objective of experimenting the CBA on some IT courses, before generalizing its adoption. In the following, we will present briefly the steps taken for the CBA implementation, we will present efforts to reconcile the CBA and the new technologies (ITC) in order to facilitate the adoption of this approach to the various stakeholders.

Our implementation process of CBA was based on the chronology of stages that begins with the description of competencies, the identification of the degree of development expected at the end of the training, the identification of the internal resources to be mobilized, the spread of competencies throughout the training, the identification of the pedagogical modalities, assessment methods, identification of the organization of the work of trainers and students and, finally, the establishment of monitoring learning methods.

In this process, we needed:

- Defining a competency framework,
- Correspondence between degrees, trades and profiles,
- Linking competencies to educational content and activities via the Learning and Assessment Situations (LAS), using existing resources in the Learning Management System Moodle used by the High Schools of Technology Fez (http://elearning.usmba.ac.ma/) and the tools of the "Francophone Network for Reusable educational resources "(REFRER: http://www.refrer.licef.ca/),
- Evaluating the production (LAS) quality,
- Capitalization and semantic referencing of the CBA educational resources,
- Retrieving learners' progressions in terms of competencies,
- Managing Learning Profiles (Implementing the Student Portfolio),

In order to set up a competency framework we were guided by the European Norm e-Competence Framework (e-CF:

http://www.ecompetences.eu/) which provides a reference of 40 competences as applied at the Information and Communication Technology (ICT) workplace, using a common language for competences, skills, knowledge and proficiency levels that can be understood across Europe. The European e-Competence Framework provides a common language to describe the competences including skills and knowledge requirements of ICT professionals, professions and organisations at five proficiency levels, and is designed to meet the needs of individuals, businesses and other organisations in public and private sectors.

To meet our immediate needs in the CBA implementation process, we have developed a module for the management of student competency profiles (Figure 3), this module is integrated into the document management system (developed by us) dedicated to the management of student's records, this module allows to:

- Create an entry profile for each student enrolled in one of the FHST fields
- Update the student's profile (Add a competency, remove a competency, change the level of a competency already acquired).
- Search an approximate competency profile
- Display the change history of a competency profile
- Display a student's competency card

To manage the LAS we have also designed and developed an application that allows to:

- Create new LASs and associate them with the competencies of the framework (e-Competence).
- Add links to the resources of e-learning platform Moodle of the university or REFRER.
- Search for LASs according to several criteria (title, target competency, level of difficulty, keyword, description)
- Changing a LAS.
- Assess the relevance of a LAS by assigning a score of 1 to 5.

To benefit more from technological advances regarding the ITS we propose to integrate our previous achievements into a global architecture whose description is detailed in the following sections.

INHERENT DIFFICULTIES IN BUILDING AN ITS

The challenges of designing and building an ITS (Intelligent Tutoring System) are not simply a question of engineering in the "traditional" sense of the term, i.e. building a solution based on pre-existing knowledge. The history in this field has shown that to approach the construction of the ITS by only exploiting knowledge already developed (on the one hand, knowledge in psychology or in education and, on the other hand, knowledge in computer science) does not lead to satisfactory results [29].

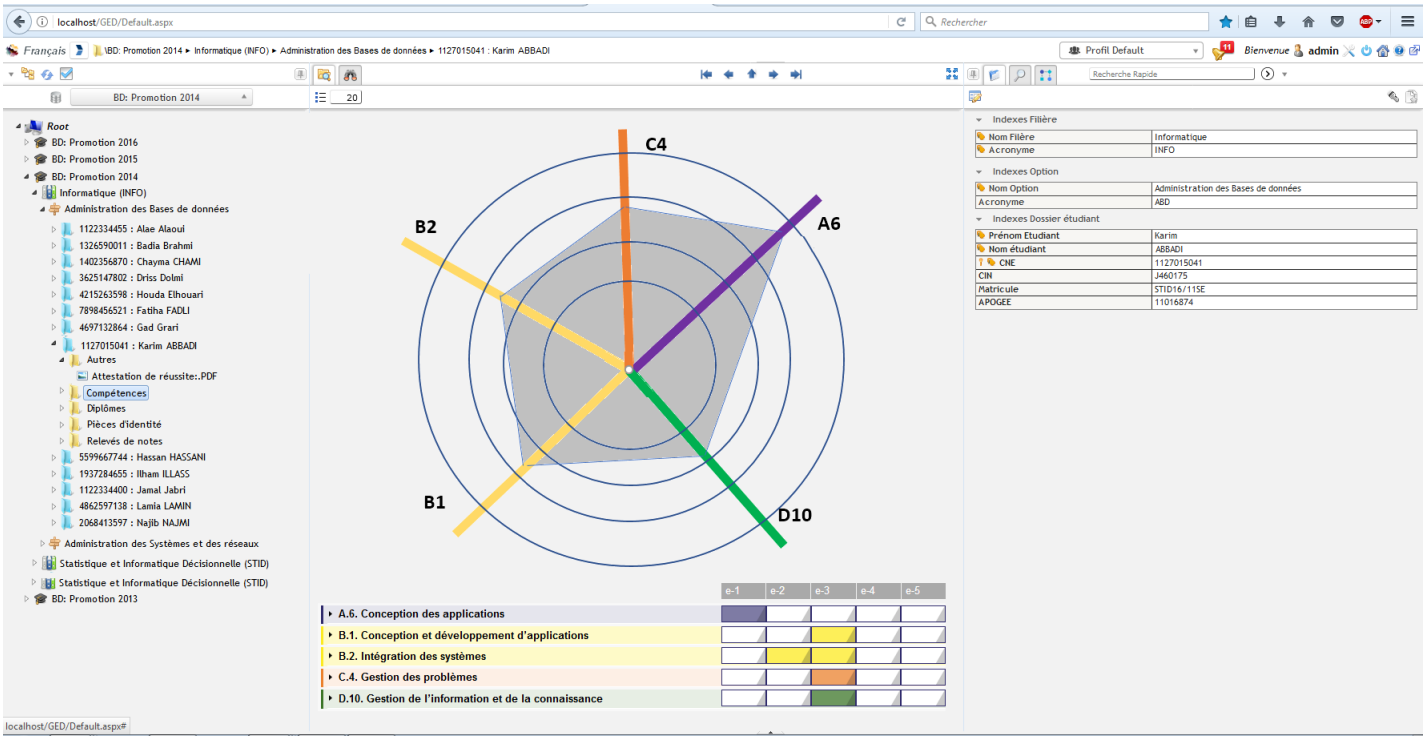

Figure 3: Competency profile management Module

The construction of an ITS for a research project is different from an engineering work in the classic sense, i.e. to build a solution [30]. A first difference is the fact of being a research work. From the point of view of research, designing an ITS is a way to study scientific problems. The achievement of the ITS is not an end in itself. A second difference concerns the perception of the issue. From the engineer's point of view, it is a question of finding a solution to the problem of having an ITS meeting the specifications. From a researcher's perspective, it is a question of isolating and defining scientific problems, (If applicable) to specify an ITS that pose and expresses these problems, to develop knowledge related to this problem, to evaluate these proposals, to analyze them and to compare them with other proposals, to define their area of validity, to situate them in relation to the scientific knowledge, and to study their impact.

In an experimental field, such as designing an ITS, seeking to design and construct an ITS raises many problems, these problems may involve diversified questionings:

- Fundamental problem coming within a given discipline: Building the ITS is therefore a potential vehicle for this discipline progress. For example, the construction of an ITS can offer an analysis perspective or useful data for the examination of a particular teaching problem, or even a problem of computer modeling of knowledge.
- Fundamental problem of the ITS as a transdisciplinary field: This is the case with fundamental questions such as the perception and understanding of the learner's activity in a computerized teaching situation, measuring instruments in relation to the learner or the calculation and the implementation of feedback by an ITS.
- Problems specifically related to the engineering aspect, i.e., problem consisting in the construction of a solution to a specific problem. From this point of view, the validity of a solution is linked to its adequacy to the problem at hand. Its character of "good" or "best" solution will be established in relation to external criteria, for example for an ITS, the notions of utility, usability and acceptability. One of the challenges is then to take into account the contingency of the work (and hence the results).

The construction of an ITS environment involves difficulties related to the nature of the activity that it claims to provide. We consider that these difficulties are to be grouped in two major clusters: difficulties in translating the didactic intentions and difficulties in operationalizing the designed artifacts.

The purpose of an ITS is to provide a computing environment that conveys a didactic intention. According to Tchounikine [31], the modeling of such didactic intention is judged to be the main difficulty. Indeed, it's a question of modeling a static component (a set of knowledges specific to a given field) and a dynamic component (a pedagogy translated into a set of interactions that the learner is likely to have with his environment). This difficulty is accentuated by the polymorphic aspect of the environment (behavioral change, competing interventions of several actors, emergence of implicit knowledge resulting from the process of learning, etc.).

The second type of difficulties concerns the implementation of a pedagogical modeling and its translation into operational elements on execution environments [32]. This operationalization must face the fact that the platforms and the associated tools often focus on a specific type of educational production (documentary, activity or other), whereas the learning situation process often involves a multitude of psychological and educational approaches.

OUR ITS CONCEPTUAL ARCHITECTURE FOR COMPETENCY BASED LEARNING IN HIGHER EDUCATION

Based on our analysis of the CBA, our experience of the processes of CBA adaptation in Hight School of Technology Fez Morocco and the needs we have felt during four years of CBA practice, and the multitude of attempts to introduce new technologies into CBA practices, we present here a proposal for a conceptual architecture of our ITS (Figure 4) integrating the CBA, such an architecture would allow us to put our achievements during adoption of the CBA into a more general and structured context, of course, our ultimate goal is implementing the various fundamental aspects of the CBA to allow the various stakeholders in teaching process to intervene, and facilitating the adaptation of the learning to needs and expectations of learners in e-learning environment.

A. Competency Acquisition and assessment Module

"Designing and implementing learning scenarios by assessment" Module

The aim of this module is to make a summary assessment of the new learner to try to give an approximate competency profile, this profile will be constantly compared with the profile targeted by the learner. Based on this comparison, the system will propose customized scenarios of learning through the learner assessment, the learner's results will be used to update the learner's profile and to adjust the proposed scenarios. Depending on the progress of the learner, several iterations will be necessary to reach the target profile and complete the training. At the end of the training, evaluation situations will be provided to the learner to certify his / her achievements and to attest his /her successful completion of the training.

Pre-assessment system: It is a system intended primarily to certify the learner's prior learning, always in terms of competencies, to prepare the inputs of the platform for a possible personalization of the teaching provided for the different profiles learner. It is also expected to be able to create a potential competency profile for anyone applying for training,

in two ways:

- Certified competencies: confirm prior learning in terms of competencies.
- No certified competencies: express prior learning in terms of competencies**.**

Assessment of acquired competencies: A global assessment system will be used to calculate the similarity in profiles and to draw up a profile matching plan for the customization of training path. It would be to define a metric to assess the gap between the current profile and the target profile (corresponding to a diploma, for example). Indeed, a mapping of the current profile with the target profile is necessary to measure the feasibility of the training. Where appropriate, an alternative goal is proposed (more reasonable intermediate step).

This metric should evaluate the gap between two levels (eg "low" to "high") when competency is present in the learner's current profile and in the target profile, and the gap between a competency not present in the profile of the learner and a competency present in the target profile.

"Collecting, Analyzing and tracking activities" Module

It is essential to have a tracking system that makes it possible to trace each handling of a situational problem:

- Keep track of learner progress
- Customizing and optimizing learners' progress
- Capitalize user experiences to improve the system
- Log the activities for regulatory and audit purposes.

"Competency profiles management" Module

The learner is characterized by a profile, expressed in terms of competencies, certified by acquired diplomas, so-called profile, and an effective profile. A system in interaction with the learner will be able to provide an estimated profile of the learner through the evaluation system. This profile will be stored in the learner Profiles DB, it will be updated every time the learner makes a progress.

This module should be able to compare the learner profile and the target profile to calculate the gab in between.

"Learner Profiles" Database

Learner profile: The learner is seen from a «Competency» point of view, the CBA makes the learner the center of the learning process, which requires a modeling considering all learner aspects and evolution over time. It is an evolutive, adaptive model that contains personal and professional information and acquired competencies as well as achievements, experiences and history.

B. "LAS Design and production" Module

"LAS management" Module

This module will assist and validate all production in relation to the CBA specifications: A support system for the construction of Learning and Assessment Situations (LAS) will be dedicated to assist both the content author and the teacher, in order to construct LAS in accordance with the targeted competencies and in accordance with the guidelines for the development of LAS. This LAS will be linked to competencies on the competencies dictionary.

Specification of resources required for LAS

It is difficult to identify and to define in advance all the necessary resources that could be used to handle LAS. It is therefore necessary to enable the learner to access the different types of cognitive resources provided by other e-learning platforms.

This module will act as a gateway between our system and other content-based systems. It will enhance the LAS, indeed, when a learner proposes new resources and justifies their successful use in handling the LAS, the resources prescribed for processing the LAS will be automatically updated.

LAS Banking

The competency-base represents the equivalent of a meta-model (or structure) that must be followed when developing programs and feeding the competency-base, the LAS represent the resources of the CBA that must be produced and updated and shared to enrich the system. Indeed, the professional area is evolving all the time and raises new problems that must be transferred on the competency-base of the LAS to maintain its conformity with the real world.

Enabling the capitalization of CBA resources: Semantic referencing of the CBA teaching resources, in this case the LAS, which are fundamental resources for the CBA learning process, would make it possible to capitalize these resources in a structured warehouse according to several semantic dimensions, inter alia, the mobilized competencies, the level of difficulty, the purposes, etc.

C. Competency Base Management System

This Module will contain a set of tools for:

- Defining competencies.

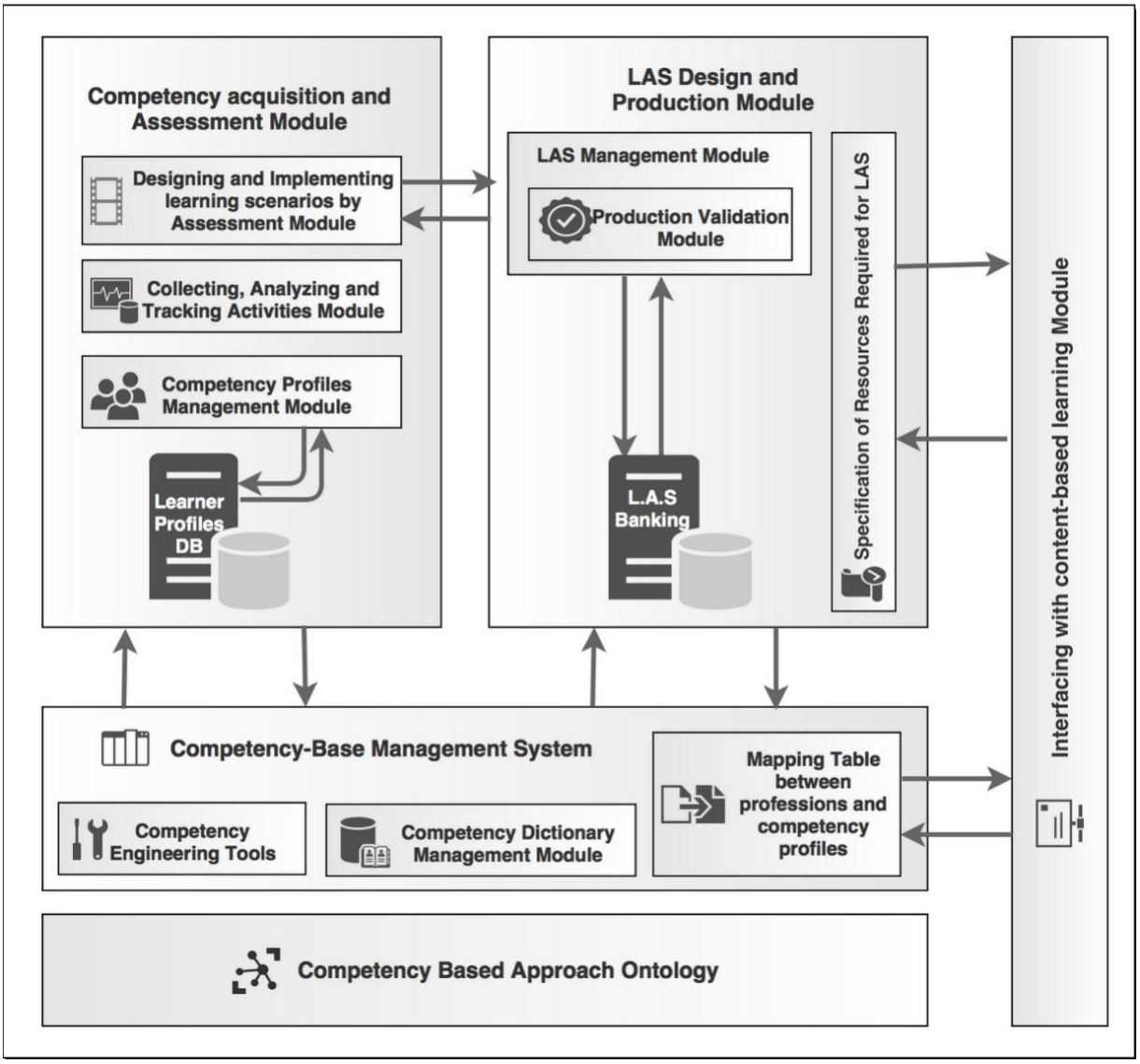

Figure 4. The ITS Conceptual Architecture for CBA

- Feeding the competency-base.
- Query the competency-base (description, relationship, prerequisites, resources - teaching, semantic search, canvas ...).

Competency Engineering tools

It is important to equip this architecture with appropriate set of competency engineering tools inspired by the human resources management tools:

- The construction of profiles in line with the real needs of the labor market and in compliance with the applicable regulations,
- The proposal of refresher courses to adapt existing profiles to evolving needs.
- Optimization of training pathways.
- Effective management of human resource assignments at workstations.
- The mapping of collective competencies.

Competency Dictionary management module

The competency-base is the core of the platform, whose design is based on the ontology and taxonomy of competencies. The architecture of the competency-base will allow to organize and to reference the different teaching resources. It will contain the description and composition of the programs in terms of competencies, around which the databases of LAS will be built.

Building a dictionary for all competencies offered in curriculums: The competency-base should be organized as a standardized, common and shared competencies dictionary, the guarantor of the integrity of this dictionary is obviously the CBA ontology, it will be the core of any system based on the CBA, all curriculum and diplomas will be reformulated in terms of this dictionary. It goes without saying that it will be necessary to design and implement tools for feeding, updating

and consulting the competency-base.

Mapping table between professions and competency profiles

It is important that this system can build an estimated learner competency profile, for learners from the professional background. To do this, it is necessary to establish correspondence between diplomas (professions, e-portfolio, badges, experiences, CVs, …) and competency profiles.

D. Interfacing with content-based learning Module

As the CBA, does not exclude other pedagogical approaches, and since all competencies rely on content (knowledge, know-how, etc.), it is imperative to ensure the interoperability of our platform with content based learning platforms.

Indeed, there should be planned moments where learners must focus on the acquisition of knowledge on traditional e-learning platforms, before they can go back to the CBA platform to mobilize the acquired cognitive resources. To do so, it will be necessary to analyze the different phases of acquisition of the competency in order to decide the appropriate moments for the knowledge acquisition. Based on the LAS description, this module will establish the appropriate gateways to supplement the resources required for the LAS handling.

CONCLUSION

In this paper, we presented the CBA and highlighted its advantages for bridging the gap between the university community and the labor market.

We have also analyzed in depth the practices of this approach to highlight its particularities as compared to the classical approaches based on the contents. In this way, based on our experience, we have tried to justify the need for a new architecture that will support and allow to integrate the technological tools into the approach practices, and more importantly to interact with the existing ITS.

Finally, we have presented our overall architecture that covers the different CBA aspects, indeed this architecture will allow us to isolate, define and study the problems that hamper the CBA adoption and its integration in the ITS, to develop formalized knowledge related to this problem, to propose solutions and to evaluate these proposals.

In our future work, we will report our progress in the implementation of the various modules of our architecture.

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