

Indexing and Adaptation of Learning Objects to the Personality of the Learner

Abderrahman CHEKRY, Aziz ORICHE, Mohamed KHALDI

Abstract— The main goal of this paper is to create adaptable learning object to different types of personality of learners. For that, we present the personality factor that we deem useful to know the psyche of learner and to create adaptable content. We lay bare two different approaches of learning profile and we propose an enrichment of Learning Object Metadata standard to support adaptation. Finally, we suggest our approach to creating learning profile and the process of adaptation of learning object.

Index Terms— Personality, Learning Object Metadata, learner profile, Ontology.

I. INTRODUCTION

Document management is an industry that has appeared since many centuries just after the appearance of writing. This sector has undergone development in libraries that contain and stock thousands of documents that are managed using catalogs. The invention of printing has revolutionized the world of documents. It has participated in their huge increase, but the origin of their management is not sufficiently developed.

New information and communication technologies have promoted the creation and dissemination of digital documents, which complicates their management; but with the processing power of computers, it is possible to manage these documents.

E- Learning is designed for public users who have different levels of knowledge and varied skills. Therefore must their presenting a content adapted to their needs [1].

II. PERSONALITY

According Fourboul "Personality is a relatively stable set of traits, characteristics that influence the behavior of individuals in response to ideas, objects or people in the environment. It corresponds to "how the person behaves in everyday life". She realizes what qualifies an individual: Permanence and continuity of modes of action and reaction specificity and originality of his of being. "[2].

A. The personal development tools

There are several tools for personal development, according to [3]; they proposed forty five tools, methods and models that are classified according to the following themes:

- ✓ Get to know;
- ✓ Improve its relationship with the other;
- ✓ Manage and motivate individuals and teams;
- ✓ Recruitment / mobility;
- ✓ Communicate;
- ✓ Support change;
- ✓ Resolve conflicts;
- ✓ Conduct effective interviews;
- ✓ Promote team cohesion;
- ✓ Developing creativity;
- ✓ Leadership and performance;
- ✓ Stress Emotion;
- ✓ Problem solving;
- ✓ Develop self-esteem.

The theme we are interested in our research is the theme of "Get to know". We will use the **Golden**[®] tool to know more about the learner to adapt learning objects to his profile and designing adaptive learning objects.

B. Get to know

The learner is the main actor in the process of learning, which requires his active involvement and responsibility in this process. During the generation / presentation of educational content, it is necessary to take into account a number of information, such as the interests, needs, psyche, learning style etc.. of the learner in order to maximize the success rate by the basis of a personalized educational content and customized.

We propose the use of test tool personality Golden to better define the personality of the learner and at the same time to create learning objects adapted to different types of personalities.

C. Presentation of Golden

Golden is a psychological tool that allows a very comprehensive and detailed personality approach; it is based directly on the theory of psychological types of Carl Gustav Jung and major works on personality traits. It is perfectly used for:

- ✓ Get to know;
- ✓ Improve its relationship with the other;
- ✓ Communicate;
- ✓ Resolve conflicts;
- ✓ Stress Emotion;
- ✓ Develop self-esteem.

Its richness lies in the dual approach of personality. It combines the approaches of psychological types (four dimensions from Jungian theory) and those personality traits (from the work of Eysenck, Allport and the theory of the Big Five) [3].

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The innovation of Golden comes with a new dimension that allows specifying the emotional stability of a subject and how to react to stress, and to assess the degree of anxiety or worry. The five dimensions of Golden come in eighteen subscales bipolar, allowing a deeper understanding of self and gives rise to a unique profile.

E: Extrovert / I: Introvert:

This dimension indicates that individuals direct their attention either to the outside (E) or to the inward (I). Subscales of this dimension are:

- ✓ Expansive / calm;
- ✓ Bold / Reserved;
- ✓ Open / Secret;
- ✓ Participatory / Withheld.

S: Sensing/ N: iNtuitive:

This dimension indicates the manner in which individuals gather information, with a tendency to focus their attention on the realities favoring the present (S), or with a tendency to focus their attention on what is becoming or emergence privileging the future (N). Subscales of this dimension are:

- ✓ Factual / Abstract;
- ✓ Pragmatic / Innovator;
- ✓ Traditional / Original;
- ✓ Classic / precursor.

T: Thinking/ F: Feeling:

This dimension indicates the methods for decision making by individuals in accordance with objective criteria and logical (T) or subjective (F). Subscales of this dimension are:

- ✓ Impartial / Empathetic;
- ✓ Detached / Compassionate;
- ✓ Logic / Subjective;
- ✓ Fighting / Cooperating.

Z: organiZation/A: Adaptation:

This dimension indicates how individuals enter the outside world and how they interact in an organized and proactive manner (Z), or a flexible and responsive (A) way. Subscales of this dimension are:

- ✓ Planner / Flexible;
- ✓ Structured / Soft;
- ✓ Cautious / Spontaneous;
- ✓ Conformist / non Conformist.

Tense / Serein:

This dimension indicates how individuals react to anxiety and stress. Expressing their level of emotional stability (Tense) and adaptation criteria developed in these circumstances (Serene). Subscales of this dimension are:

- ✓ Anxious / Optimist;
- ✓ Worried / Insured.

III. LEARNER PROFILE

A learner profile is the set of information that is used by a system (platform e-Learning) to adapt teaching content to the skills, knowledge and preferences of the learner.

In our research we propose a new approach to learning profile based on the work of the team Sampson [4] and the team Carchiolo [5].

A. Sampson team approach:

The work of the team Sampson emphasizes the work of the European IST project KOD "Knowledge on Demand". One of the objectives of this project is to facilitate personalized access to learning objects; i.e. they will be presented to the

learners according to their individual profiles.

The KOD system is based on IMS LIP [6]. To maintain the learner profile, the learner is entitled to complete a short quiz shown in the figure 1 at its first registration in the system to determine their personal data, preferences, accessibility, performance and learning objectives. These information is stored in an XML file.

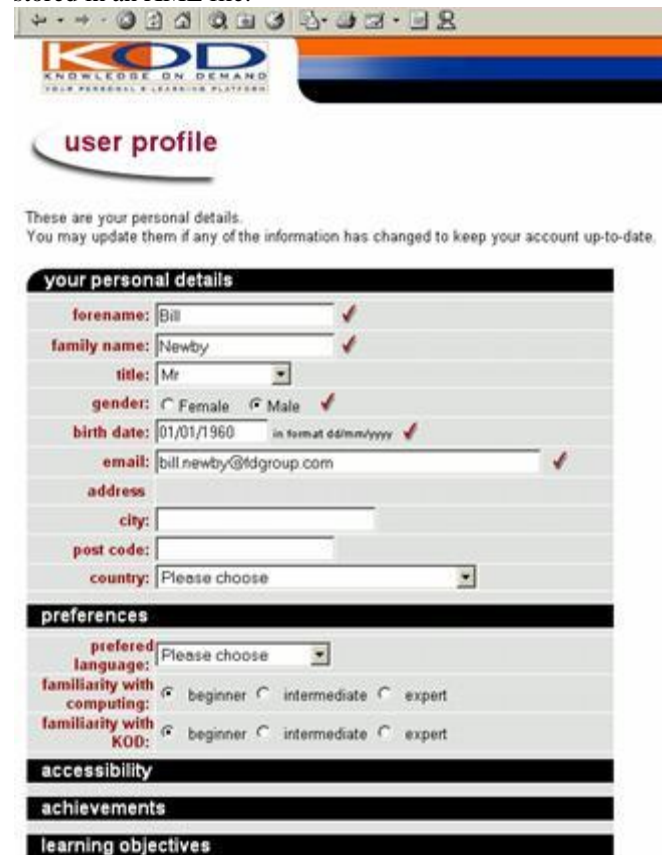


Fig 1. Initial questionnaire for the learner profile in the KOD system.

The learner profile is updated according to the interactions of the learner with the KOD system, namely its responses to the evaluation questions, for example.

B. Carchiolo team approach:

For Carchiolo team a learner profile is exploited mainly to describe the knowledge and preferences of the learner in order to allow the generation of personalized learning path. Specifically, a learner profile is defined as a triple:

$$\text{StudentProfile} = \{GI, CI, SI\}$$

For ST learner's learning profile is defined as:

$$\text{StudentProfile}_{ST} = \{GI_{ST}, CI_{ST}, SI_{ST}\}$$

Where:

GI_{ST}: Contains general information about the learner ST, GIST is defined as 4-tuple that includes:

1. **SPD_{ST}**: Represents the personal data of the learner ST, i.e. name, identification code, registration data, etc.. These data are simply used for the identification of the learner;
2. **MS_{ST}**: Represents all appropriate media for the learner ST (eg, a deaf student can not use the audio formats);

3. STK_{ST} : Represents all knowledge of the learner ST, this knowledge is described by a set of keywords selected from the domain ontology and are initially provided either manually or by the learner during the entry into the system, or they are obtained through tests of knowledge of learners;

4. H_{ST} : Represents all the information necessary to keep the history of the learner ST, ie logs, test results, etc.

CI_{ST} : Contains specific information about the courses. This information is used to manage the learning process of the learner ST, more specifically they are used by the module course presentation. Course i is thus presented by $CI_{ST,i}$ which includes:

1. $Cident_{ST,i}$: Represents the identifier of the course i of the learner ST;
2. $PathTree_{ST,i}$: Represents the possible learning path leading to the aim of the course i;
3. $LastNode_{ST,i}$: Represents the last lesson of the course i;
4. $INIT_{ST,i}$: Represents the initial knowledge of the learner ST for the course i;
5. $GOAL_{ST,i}$: Represents the knowledge attainable by the learner ST for the course i.

SI_{ST} : Contains information about the session of the learner ST, SI_{ST} is defined as 8-tuple that includes:

1. SAT_{ST} : Represents the time available to the learner ST for the current session;
2. DLL_{ST} : Represents the desired learning style by the learner ST (for example, theoretical oriented, practical oriented, etc.);
3. DLD_{ST} : Represents the difficulty expressed by the learner ST, expressed as a numerical value ranging from 1 (basic) to 5 (advanced);
4. DL_{ST} . Represents the desired level of detail expressed as a numerical value ranging from 1 (easy level of detail: used when the learner ST wanted to have an overview of concepts) to 5 (used when the learner ST wanted to do a study depth);
5. DCC_{ST} Represents the desired course creator (used when the learner ST would select a specific teacher);
6. M_{ST} : represents all the media used in the current session;
7. DLP_{ST} : Represents the path of the current learning;
8. CCC_{ST} : Represents the identifier of the current course.

IV. INDEXING

Indexing of documents is a discipline of information science and library and computing that is based on computer tools to create an index for a set of documents to facilitate access to documents later.

In our approach, we propose the use of the LOM standard for indexing learning objects, while enriching it with new specific metadata for determining the psychological type of learners to create a content adaptable to different types of personalities.

A. Enrichment of LOM

The phase of description of the learning object is very important to ensure the sharing and management. The LOM standard is the most suitable and widely used one than other initiatives such as the Dublin Core to facilitate the sharing and reuse of learning objects by means of metadata. But this standard does not support the personality and psychology of learners who are the most sensitive consumers.

To overcome this problem, it is necessary to add new metadata, which led us to propose a new descriptor "5.12

relevance" in the category of LOM standard "5 Educational." This descriptor is intended to express the relevance and adaptability of the learning object to the different personality types of learners.

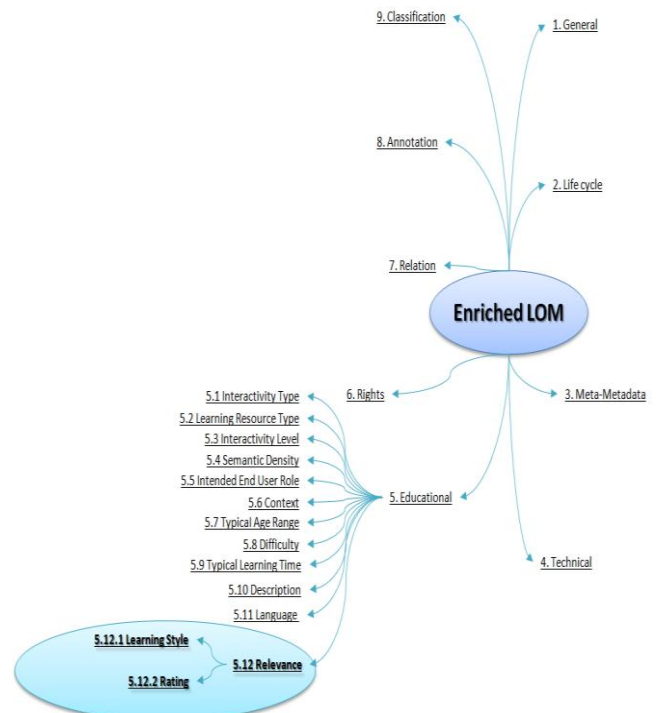


Fig 2. Enrichment of LOM by new metadata.

For the descriptor "5.12.1 Learning Style" mentioned by the tutor at the time of creation of the learning object, it is specified based on the Golden psychological tool that determines the learning object relevant to a specific type of personality, and it may be used for the composition / generation course for this type of personality, which allows a better adaptation of the content.

For the descriptor "5.12.2 Rating", it is often calculated based on rating given by students to the course. This descriptor will be useful for the classification of learning objects into two states:

✓ **State1:** In their search by tutors, learning objects which have a higher rating will be reused in the creation / updating of courses, while learning objects which have a low rating should be improved by their creators.

✓ **State2:** During the generation of the course to the learner, the learning objects which have a higher rating are more likely to be combined in the composition of the course.

The formula for calculating the rating is as follows:

$$Rating = \frac{\sum Rate}{NB_Learners}$$

$\sum Rate$: The result of the sum of all rates given by the learners;

$NB_Learners$: The number of learners who have rated the course.

B. Ontological modeling

In our research, we proposed two types of ontologies: domain ontology and learning object ontology.

Domain ontology:

This ontology aims at modeling the knowledge of a learning area. The course will be decomposed to very fine granular concepts (grains of knowledge), which allows for the characteristics of a learning object (granularity, reusability, Aggregation, interoperability etc.) for flexible learning.

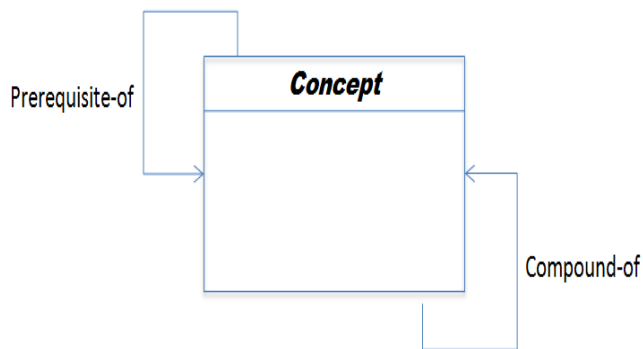


Fig 3. Domain ontology.

"Prerequisite -of " is a relationship between two concepts, e.g. A and B of the same ontology, if A is a prerequisite of B: the learner will be informed that to learn the concept B he must understand the concept A before that.

"Prerequisite -of " is a relationship which means that the description of a concept A (parent) is performed from the description of its components (son). This allows concepts increasingly more simplified and adaptable to different levels of learners.

Learning object ontology:

A learning object is a set of granular bricks which can be a definition, an introduction, a summary, an example, a remark, exercise, evaluation etc. These are combined in a way that transfers knowledge adapted to a profile learner.

The learning object ontology must contain all concepts and relationships between these concepts in relation to the notion of learning object.

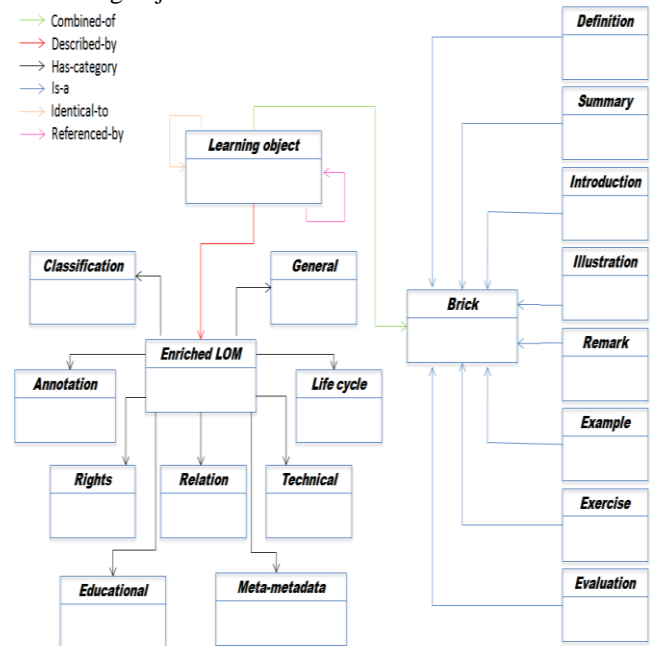


Fig 4. Learning object ontology.

Ontology "learning object" contains two main classes:

✓ The "Brick" class: that divides a learning object in

different elementary bricks (definition, synthesis, introduction etc.).

✓ The "Enriched LOM" class: providing a detailed description of a learning object by metadata (title, language, author, etc.), belonging to different categories (General, Pedagogy, Rights etc.). This metadata allows having all information for efficient search of a learning object.

In addition, our proposal of enrichment LOM will enable us using the descriptor "Learning Style" to deal with different learning styles for learning object, which is adapted specifically to a given personality type Golden.

This descriptor is entered by a pedagogue who knows the content and its uses. It can be changed manually by the teacher or automatically by the system (based on traces of use of content by learner profiles).

For example: learning object with the style:

$$Style_{L.O} = \{E=15\%, I=7\%, S=4\%, N=32\%, T=3\%, F=28\%, Z=8\%, A=3\% \}$$

determines that this learning object is suitable for the type of personality and Golden ENFZ for a learner who has definite preferences.

We defined two semantic relationships between learning objects:

- ✓ "Referenced-by " that lets you know that the learning object is referenced by another object (an antisymmetric link);
- ✓ "Identical-to " that lets you know that the learning object is semantically identical (similar) to another object (a transitive and symmetric link).

Figure 5 shows the relationship between "Domain ontology" and "Learning object ontology ":

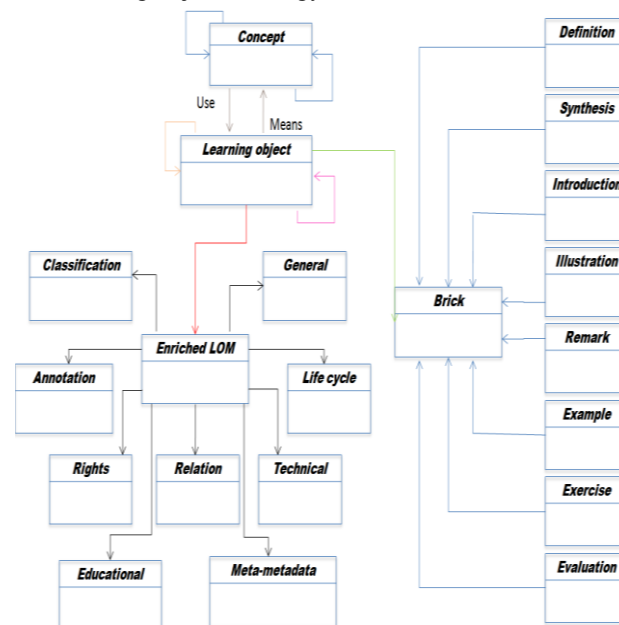


Fig 5. Complete ontology.

Relationship "Use" connects a concept of ontology to one or more learning objects, which offer direct access to the knowledge needed to learn a concept, while the relationship "Means" connects a learning object to a concept.

V. ADAPTATION OF LEARNING OBJECTS

The definition given by Webster's dictionary [7] "Adaptation is the action to adapt or adjust to something: Adapting to circumstances e.g." which means adjust, arrange, join, assemble. This is a general definition of the term of adaptation.

In the field of education, the adaptation is "an attempt to alter the interactive behavior of a system by considering both the needs of individual learners and human conditions to the application environment" [8]. According to this definition the individual needs of learners and the environmental conditions of the application are the fundamental elements to achieve adaptation.

A. New approach of learner profile

We propose a new approach of learning profile that is based on the work of the Sampson team and Carchiolo team and incorporates the use of psychological Golden tool.

During registration, the learner is asked to complete a form which will be the first step in defining his profile. The system stores the general information (name, date of birth, address, login etc..) In an RDF file, then he is asked to answer a questionnaire, then psychological Golden will be positioned in a well determined personality type (**StyleI**).

Based on this style, the content will be adapted to the needs and preferences of the learner wants to be comfortable in the process of learning. The learner profile is enriched by the progression of learning and by history of the learner in the system.

A learner profile will be defined as a 4-tuple:

$$ProfilApprenant = \{GI, CI, SI, StyleI\}$$

Where:

GI : Contains general information about the learner;

CI : Contains specific information about the courses;

SI : Contains information about the session of the learner;

StyleI : Contains information about the type of personality of the learner. This indicator will be measured by the learner responses to the various questions of the Golden psychological tool. According to Table 1, there are 16 personality types. For example, ENFZ represents Extraversion, Intuition, Feeling and Organization which are the most significant preferences of the learner than others.

Tab 1. The 16 personality types [3].

Préférences psychologiques Les 16 types		SENSATION		INTUITION		Serein	Tendu	STABILITÉ ÉMOTIONNELLE
		Pensée	Sentiment	Sentiment	Pensée			
INTRO- VERSION	Organisation	ISTZ	ISFZ	INFZ	INTZ			
	Adaptation	ISTA	ISFA	INFA	INTA			
EXTRA- VERSION	Adaptation	ESTA	ESFA	ENFA	ENTA			
	Organisation	ESTZ	ESFZ	ENFZ	ENTZ			

B. Ontological learner modeling

The ontology learner must contain all information about the learner (courses, histories and learning style).

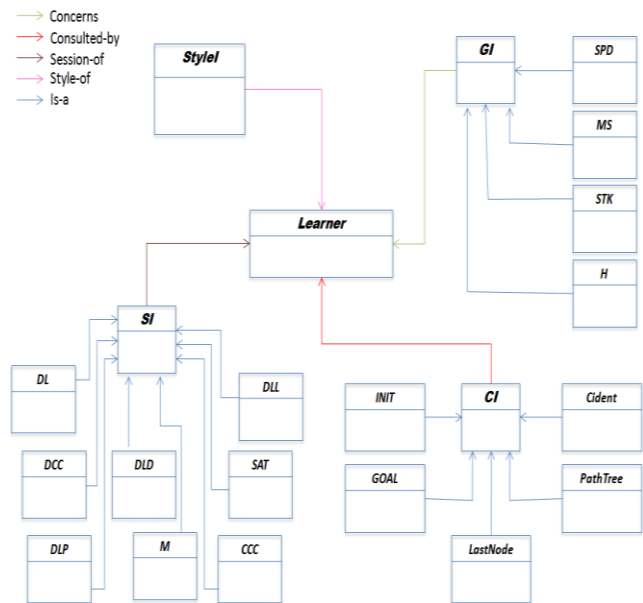


Fig 6. Learner ontology.

C. Adaptation process

During registration of the learner, the later is required to answer a questionnaire, then psychological Golden will identify personality type. The system starts registering preferences of the learner in a learner profile, subsequently the learner selects the concept he wants to learn. The process will treat this concept according to the following phases:

1. Identification of learning objects that are used by the concept;
2. Selection of learning objects that have the same learning style of the learner;
3. Combination of learning objects in a consistent way.

Figure 7 illustrates the process of adaptation:

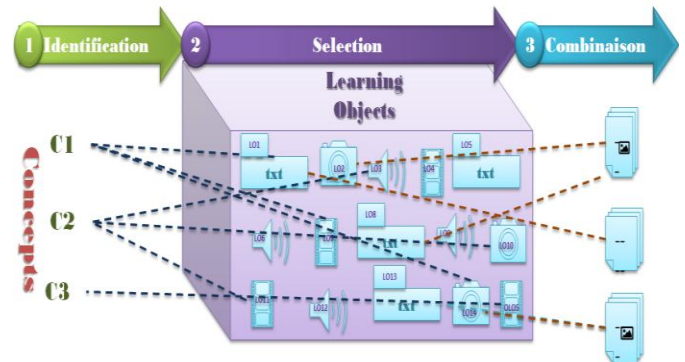


Fig 7. Process of adaptation.

Identification of learning objects:

When the learner selects the concept he wants to learn, a request will be sent to the database of learning objects. We know that each learning object is related to the concept it designates, which will afford the identifiers of learning objects that mean the Treaty concept.

To improve the quality of the results we propose the use of an inference engine, which will be based on the semantic relationships between learning object ontology and inference rules used.

Inference rules will be published by the OWL language. This language is the basis for the development of inference engines and will allow us to deduct from the relevant learning objects new learning objects while referring to the semantic relations and SWRL rules.

Selection of learning objects:

After the identification phase, we will have, as a result a set of learning objects explicitly or implicitly inferred identified.

The selection phase involves comparing the descriptor "learning style" of learning object with "StyleI" of learner profile in order to select suitable learning objects for the learner profile, which provides a better understanding of knowledge presented to the learner.

Combination of learning objects:

This phase consists in ordering learning objects (chosen in the identification phase) in a course.

In order to have a coherent course we propose feeding the database of learning objects with learning objects of all types of formats (image, video, text, sound).

When the number of learning objects increases, we propose the use of other filters to select fewer learning objects with top quality.

VI. CONCLUSION

Indexing is a very important step for the creation of learning objects, which promotes quick access to accurate and relevant research and ensures the reuse. In addition, the adaptation of learning objects to the preferences of learners facilitates the assimilation of knowledge and fluency of learning.

In this paper, we have tried to expose the personality factor that we deem to be useful in knowing the personality of learning and create adaptable content. We have studied the tool Golden personality test to determine personality of the learner. We have presented two different approaches to learner profile and we have proposed an enrichment of the Learning Object Metadata standard indexing that can support adaptation.

Finally, we have presented our approach to creating learners profiles.

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