Proposition and Organization of an Adaptive Learning Domain based on Fusion from the Web

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ABSTRACT
The Web allows self-navigated education through interaction with large amounts of Web resources. While enjoying the flexibility of Web tools, authors may suffer from research and filtering Web resources, when they face various resources formats and complex structures. An adaptation of extracted Web resources must be assured by authors, to give reliability, satisfaction of learners and content quality of E-learning platform. This study has proposed Fusion of Web resources approach to this problem and organized resources to an Adaptive Learning Domain into E-learning platform. The focus was firstly, on searching tools and filtering methods to extract the most relevant educational Web resources and structuring them to create courses, secondly, on adaptation of extracted Web resources. Our approach explores a new process of fusion in creation and in adaptation to learner’s profiles. That approach doesn’t need much time and many efforts which can be taken and done by authors to create courses. It also finds direct way to Web resources which are needed, and the update of courses that can be done directly from the Web with the reuse of extracted resources. The evaluation of this work has given high performance in comparison with different methods of course's creation.

Keywords
Web resources, Adaptive Learning Domain, Fusion, E-learning Platform, and Learner Profiles

Introduction
Technology has created cyberspace and decomposed national and international barriers. Today anyone possesses computer, modem and supplier access which can be connected to the new means and enjoy its many gifts. Everyone can teach and anyone can learn what, when and where he wants. Nowadays, the rapid technological revolution has changed the world totally, especially at the level of knowledge and information’s transfer inside and outside the university, thus gives new type of higher education fundamentally different from the previous one (Brusilovsky, 1999). Online education as a tool for distance learning is considered as a teaching method that allows teacher and learner to be separated from each other in time and in place while they are remaining connected by an appropriate technology (Kolb, 1984). In online education, the separation time and space is filled by ICT (Information and Communication Technologies) networks, including the Internet and World Wide Web. E-learning is useful in education, business and all types of learning. Through this method, money and time can be saved. In addition to, producing measurable results (Amaral & Leal, 2006; Arthurs, 2007; Bostrom, Olffman & Sein, 1990; Brusilovsky, 2004). E-learning is mainly the network transfer of skills and knowledge in E-learning platform by using electronic applications and learning process (Brooks, Kettel & Hansen, 2005; Rodica & Anca, 2008).

With the rapid development of digital technology, information has become a very important area of research through which researchers open doors on several researching areas, such as indexing, backup and representation of information (Senan, 2008). And then, it has a responsible way for each course preparation in online training, but it also requires some steps, especially the selection of the most relevant information (Chaoui & Laskri, 2011b). Information is available in several formats on the Web, particularly in text format flexible to any changes and can be updated also by authors and learners. This change and update make the task of adapting the information very difficult and not completed process (Canales et al., 2007; García-Barrios, 2006; Monova-Zheleva, 2005; Rosmalen et al., 2006; Ruiz et al., 2008). Additionally, the amount of learning materials on the Internet has grown rapidly in recent decades. Therefore, the information’s consumers are challenged to choose the right things. In E-learning systems, most approaches have led to confusion for learners. For that, adaptive learning has gained much attention in this area (Chaoui & Laskri, 2011a; Monova-Zheleva, 2005; Papanikolaou et al., 2002; Rey-Lopez et al., 2009; Sampson, Karagiannidis & Cardinali, 2002; Wang, Wang, & Huang, 2008; Yang & Wu, 2009; Yessad et al., 2008).

Our aim through this work ProOALDoF-Web “Proposition and Organization of an Adaptive Learning Domain based on Fusion from Web” to reduce the huge space of the Web which contains billions of Web pages, that huge space becomes personalized one with direct learners’ adaptation to meet their satisfaction and to provide good training which can be changed and updated, but with reliable and academic resources.
The rest of the paper is organized as follows: in the first part; we give background and related works. In the second one we detail our project "PrOALDoF-Web", its algorithm and different steps to create courses, justifying our ideas and the new approaches and developed methods throughout the implementation of PrOALDoF-Web. The importance of our project is the adaptation and is not the definition of learner’s model for tracking learners and subsequently the decision of learners’ levels in order to adapt the appropriate courses, but we assume that learners’ levels are introduced into the system. The third part is evaluation in comparison with our approach and different methods of courses’ creation.

**Adaptation in E-Learning Systems and adaptation in our Approach**

The point which makes E-learning more practical than the traditional methods of learning is: E-learning can be addressed to the maximum number of participants with diversity of learning styles, preferences and needs. For this, any adaptive E-learning system must have high quality of training (Akoumianakis, 2011; Lee, Hsieh & Hsu, 2011). In addition to, E-learning has advantages such as reducing overall costs and time, proving that completion and certification are essential elements of training initiatives such as: interactivity and the ability to deliver consistent contents which are needed according to demands (Kruse, 2004). These E-learning environments have made satisfaction to the demands of learners, who have a central role in learning, for that these environments have become increasingly popular (Chen, 2009; Lee, Hsieh, & Hsu, 2011; Monova-Zheleva, 2005; Rosmalen et al, 2006, Wang et al., 2010). The main point of such popular E-learning system which must be put under consideration is to find out the learner’s preferences, interests and browsing behavior to offer adapted training (Chen, 2009, Wang et al., 2011). This consideration highlights an idea of managing an adaptive e-learning system (Brusilovsky, 1999). This method is considered as an alternative to traditional methods and opens a door for new approaches in the development of educational courseware (Akoumianakis, 2011; Caravantes & Galán, 2011; Peterson, Rayner & Armstrong, 2009; Lee, Hsieh, & Hsu, 2011; Surjono, 2009; Wang et al., 2010; Wang et al., 2011).

Much effort has been made in the field of adaptive systems to offer good user’s model in learning systems (Nguyen & Do, 2008). Most of these works are about the learning methods of learners to gain more details about learner's needs (Liegler & Janicki, 2006; Magoulas, Papanikolaou, & Grigoriadou, 2003; Stach, Cristea & De Bra, 2004; Yang & Wu, 2009). There are two different general approaches to the adaptation of learning content (Olfman, Mandviwalla, 1994; Papanikolaou et al., 2002). The first approach seeks to adapt the learning content with special needs, and the second one focuses on the provision of the most appropriate learning content to the learner’s needs. The first is called the adaptation of the content’s level and the last one is called the link-level adaptation. Neither approach can be preferred from the other one. Based on these approaches, several projects of researches have given a new methodology for appropriate content. Some of these projects are oriented to the extension of the standard learning content to improve the quality of the learning process. One group argues that current standards do not support an adaptive system, so they must be modified in some respects (Lu & Hsieh, 2008; Rey-Lopez et al, 2009; Sampson, Karagiannidis & Cardinali, 2002). In response to the fact that the metadata standards of learning content are somehow inadequate for some applications, a group of researchers have tried to replace them by the ontology that considered one of the pillars of the Semantic Web (Chi, 2009; Jovanovic et al., 2007; Lee, Tsai & Wang, 2008; Shih, Yang & Tseng, 2009; Verbert et al., 2005; Wang & Hsu, 2006; Yang, 2006; Zitko et al. 2009). Researchers have developed systems based on Semantic Web by creating an ontology used for the themes of the course. This method of modeling permits interaction between learners and systems as which have been done in the researches by (Chi, 2009, Jovanovic et al, 2007; Lee, Tsai & Wang, 2008; Shih, Yang, & Tseng, 2009; Verbert et al., 2005; Wang & Hsu, 2006; Yang, 2006; Zitko et al., 2009). There are some studies that have used a multi-agents system in adaptive learning (Canales et al., 2007; Chen, 2008). Four types of agents exist in that proposed system: The first one does the management of context, the second one does the selection of content, the third one does the organization of content and the fourth one does the presentation of content.

Our objective is to develop new approach in adaptive E-Learning systems that can be integrated with any LMS. Learning content can be reused and shared across different platforms. The source of information of that content is the Web. The method of research and filtering is based on ontology and semantic rules. The adaptation approach is based on fusion via ontology of domain and pedagogical ontology. What is new in our work is the fusion of several fragments of Web resources to increase the quality of training content and to get adaptive, reliable, rich and dynamic system; dynamic is in the sense enrichment and update.
Proposed Approach of “PrOALDoF-Web” System

In this part, we have detailed our proposed approach (as in Fig 1.) to construct the different parts of our system, and to give new tool with high performance in research and filtering of Web resources based on Degree of Relevance ‘DR’ and Distance Based on Semantic Rules ‘DBSR’. The two methods are based on ontology of domain. We have organized our course from hierarchy of ontology of domain to construct Learning Domain ‘LD’. After that, we have got Adaptive Learning Domain ‘ALD’ through the application of pedagogical ontology. Thus, contains learner levels and strategy of adaptation based on fusion. ALD presents database that contains the most relevant Web resources and with the application of fusion approach, the course content will get a high quality and the possibility of the reuse of the extracted Web resources.

![Figure 1. Proposed Approach PrOALDoF-Web](image)

**Beginning**
- Searching resources in the Web via Google API, with an automatic formulating of query based on ontology of domain; we have defined for each concept some keywords.
- Filtering based on domain ontology: we calculate degree of pertinence ‘DP’ in the first round, to reduce space of filtering. In the second round, we determine the distance between sub fragments in each fragment of each document or resource in the Web, the distance is based on semantic rules “DBSR”.
- Selecting the most relevant resources.
- Saving fragments in the New fragments Database "NFDB".
- Fusion of sub fragments content based on distance between sub fragments and semantic rules (Distance Based on Semantic Rules) "DBSR".
- After the fusion we get a new fragment which can be associated to a part of the course.
- Saving new fragments in New fragments Database "NFDB";
- Connecting “NFDB” database with pedagogical ontology to create learning domain.
- Connecting the learning domain with learners.
- Adapting course to learners to create our Adaptive Learning Domain Based on Fusion from the Web.
- Enrichment of “NFDB” database from the Web;
- Resources of the Adaptive Learning Domain can be reused directly from “NFDB” database.

**End.**

![Figure 2. PrOALDoF-Web Algorithm](image)
To create adaptive course in PrOALDoF-Web System, we have five steps: (1): Research in Web, (2): Filtering and Selection, (3): Fusion of sub fragments, (4): Construction of Learning Domain and (5): Adaptation to Learner's Profiles. To better understanding the proposed approach, we have realized the algorithm called “PrOALDoF-Web” (as in Fig 2.). We have detailed principal of PrOALDoF-Web and what is new in our project shows the difference between our work and similar projects. In the first time, method began with filtering of Web resources by applying statistical and semantic methods based on concepts of ontology and on a list of key-words for each concept, to define list of the most relevant documents for each part of a course. After that, we apply semantic method (according to semantic rules) for each fragment between terms which are key-words of each concept. For this, the two methods are complementary to give list of fragments for each concept that presents part of a course just after extracting the most relevant fragments, in online way. Those fragments are stored in database; that is to say, our two methods have given results without downloading documents, so that to minimize the time.

With the fusion approach, course can be created from different fragments that are extracted from one or more Web resources. Adaptation of the course content is based on fusion. The course content can be changed according to learners’ levels. When the level increased, the enrichment of course increased too.

(1): Research in Web

We have used Google API automatically in our system instead of using manual search through Google search engine. This API gives list of results ‘URLs’ thus can be obtained from queries. These queries are formulated automatically from keywords and annotations which are located ontology of domain, in each concept. Google API permits to filter results by types of documents (PDF, Word, etc. ...) that are given via ‘filetype’. By the application of Google API in the system, the course part chosen by author will generate a query. An example of research can be given:  Course is about Human Skeleton, Part = Head => Query = Head in Human Skeleton filetype:doc. Head in human skeleton: are keywords and "filetype:doc" specifies the criterion of filtering documents. In this example, the result is a list of URLs and documents are word (.doc) type. After that, we have used our two methods of filtering ‘DP’ and ‘DBSR’. We give further details in next part.

(2): Filtering and Selection

We have used JENA API which is functioned only in JAVA language. JENA API gives a possibility of integrating the ontology of domain (as in Fig 3.) in the system. With this API, We can read and write ontology as in these types (OWL or RDF …and so on). In our case we have OWL type. The hierarchy of the course is obtained from ontology of domain (as in Tab 1.).

Figure 3. A graphical extract of the created ontology of domain
Table 1. Hierarchy of the course from ontology of domain

<table>
<thead>
<tr>
<th>Concept 1</th>
<th>Concept 2</th>
<th>To Concept L</th>
<th>Chap. 1</th>
<th>Chap. 2</th>
<th>To Chap. A</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sub Concept 1</td>
<td>Sub Concept 2</td>
<td>To Sub Concept M</td>
<td>Subtitle 1</td>
<td>Subtitle 2</td>
<td>To Subtitle B</td>
</tr>
</tbody>
</table>

L: the last concept in ontology
M: the last Sub concept of the correspondent father concept

We have prepared with this hierarchy our Learning Domain to save, in the next time, the extracted fragments in correspondent parts of the course in new fragments database ‘NFDB’. New fragments are due to the process of sub fragments fusion. ‘NFDB’ database has new Excel model (as in Tab 2.).

Table 2. Portion of Excel Model to create ‘NFDB’ Database

<table>
<thead>
<tr>
<th>Part 1</th>
<th>Part 2</th>
<th>Part N</th>
</tr>
</thead>
<tbody>
<tr>
<td>SR1</td>
<td>SR1</td>
<td>SR1</td>
</tr>
<tr>
<td>SF1</td>
<td>SF1</td>
<td>SF1</td>
</tr>
<tr>
<td>DR</td>
<td>DR</td>
<td>DR</td>
</tr>
<tr>
<td>DBSR</td>
<td>DBSR</td>
<td>DBSR</td>
</tr>
<tr>
<td>SF1</td>
<td>SF2</td>
<td>SF1</td>
</tr>
<tr>
<td>SF2</td>
<td>SF2</td>
<td>SF2</td>
</tr>
<tr>
<td>DR</td>
<td>DR</td>
<td>DR</td>
</tr>
<tr>
<td>DBSR</td>
<td>DBSR</td>
<td>DBSR</td>
</tr>
<tr>
<td>SFN</td>
<td>SFN</td>
<td>SFN</td>
</tr>
<tr>
<td>DR</td>
<td>DR</td>
<td>DR</td>
</tr>
<tr>
<td>DBSR</td>
<td>DBSR</td>
<td>DBSR</td>
</tr>
</tbody>
</table>

In addition to use a Java Excel API; this API allows reading and writing an Excel document in Java Platform. For each part of course, we have defined some semantic rules ‘SRs’ to calculate ‘DR’ and ‘DBSR’ of each sub fragment ‘SF’ which can be found in one or multiple Web resource parts. The SRs of each course part are defined and organized vertically in the table below. And the SRs have also sub fragments that are organized horizontally; these later ones are extracted from Web resources.

After this, we have started fusion for each course part in the table. For example Part 1: we have chosen the most relevant contents which are stored in sub fragments from ‘SF1’ to ‘SFN’ for each SR, as a result from fusion we get new fragments that must be saved in the correspondent column which is called ‘FSF’ ‘Fusion of Sub Fragments’.

To obtain results of the Table 2, we must complete series of steps as follows: First, we have divided Web resources found into sections or paragraphs as follows: <P1>, <P2> … <PN>; PN is the last part of Web resources found. Then, we have used fragmentation on each fragment, the aim from that is to split them into sentences and into separate words. And then we have eliminated needless words (the, of, a, an, or, in, etc. …), So that these ones do not affect the result of two methods ‘DR’ and ‘DBSR’ that are determined below. To create course parts, we have to extract the relevant fragments in Web resources found. For that reason, we must calculate ‘DR’ in the first time to determine relevance of the appropriate course part. In the second time, we must calculate ‘DBSR’ only on the most relevant fragments to extract sub fragments that are related to the SRs defined for each course part. We can extract sub fragments from multiple Web resources fragment. Those sub fragments can be given together to one course part or dispatch them to multiple course parts. ‘DR’ and ‘DBSR’ are two original and proposed methods in our work.

Degree of Relevance ‘DR’

It is a statistical method (1), based on the frequency of ontology concept (which presents a component of the course) in Web resource fragment at the first time and the existence of keywords and their frequencies in the same fragment.
at the second time. The frequency of word in one fragment is how many times the word can be repeated in this fragment. The formula that is mentioned below used to calculate the ‘DR’ in one Web fragment.

\[
DR = \frac{F_c + \sum_{k=0}^{n}(F_k \times W_k)}{N} \quad (1)
\]

Where: 
- \(c\): Concept.
- \(F_c\): Frequency of concept \(c\) in one Web resource fragment.
- \(k\): Keyword.
- \(n\): Maximum number of keywords.
- \(F_k\): Frequency of keyword \(k\) in one Web resource fragment.
- \(W_k\): Weight of keyword \(k\).
- \(N\): Total number of words in one Web resource fragment.
- \(\sum_{k=0}^{n}(F_k \times W_k)\): Sum of frequencies of keywords \((k=0…n)\) for one ontology concept in one Web resource fragment, multiplied by weight of correspondent keyword.

To say that a fragment is relevant to one course part, we must calculate its degree of relevance over all course parts. The fragment which has the highest degree will be saved in ‘NFDB’ database, and then we repeat the process for all fragments of Web resources found.

**Distance Based on Semantic Rules ‘DBSR’**

It is a semantic method (2) based on the distance between terms in sub fragments. Firstly, we must extract terms from one sub fragment and calculate distance only between terms that are defined in semantic rules 'SRs'. ‘DBSR’ presents a projection of SRs on sub fragments of the Web resource found just to extract the most relevant appropriate sub fragments to one part of the course. When we have successive terms in sub fragment of Web resource, and some distances equal 0, ‘DBSR’ result will be near to 1. As consequence, we have to associate the sub fragment to ‘SR’. In the case of not finding sub fragments to one sub part of the course, we have to use a dictionary of synonyms terms to give more possibilities to get the needed sub fragments that contains different information defined in SR. A formula’s mentioned below for calculating "DBSR" in one sub fragment of Web resource.

\[
DBSR = \frac{\sum_{t=0}^{n}(\text{if } E_t \text{ in SF then } 1 \text{ else } E_{stn} \text{ in SF})}{N} \quad (2)
\]

Where: 
- \(t\): Term in SR.
- \(n\): Total number of terms in SR.
- \(E_t\): Existence of term \(t\) in Web resource sub fragment.
- SF: sub fragment.
- st: synonym of term \(t\).
- stn: total number of synonyms terms.
- \(E_{stn}\): Existence of all synonyms of term \(t\) in Web resource sub fragment.
- \(\sum_{t=0}^{n}(\text{if } E_t \text{ in SF then } 1 \text{ else } E_{stn} \text{ in SF})\): Sum of existences of terms or synonyms in one Web resource sub fragment.

We have repeated the same treatment for all Web resource sub fragments, to associate them to SRs in course part, and saved results in ‘NFDB’ database. After that, we must realize fusion process with sub fragments extracted from Web resources. We will give more details in the next part of paper: Fusion of sub fragments.

We have obtained comprehensive approach that meets our needs:
- The hierarchy of course is taken out from ontology of domain.
- Annotations and keywords of each concept in ontology assure calculation of ‘DR’ (1) of each fragment extracted from Web resources to find the most relevant fragments of course parts. We calculate ‘DBSR’ (2) for all relevant fragments to extract the most relevant sub fragments of course parts.
- Finally, we order the most relevant sub fragments in Excel Model to create our New Fragments Database ‘NFDB’.

(3): Fusion of sub fragments

Fusion is based on semantic rules 'SRs' between terms in each sub part of the course (as in Fig 4.) (One or more concepts have many SRs). We have created SRs to all course parts. Each ones has been associated to one part of the course.
Ontology of domain plays three roles: the first one is the presentation of the entire hierarchy of the course, as we have mentioned in the title (Filtering and Selection), it allows calculation of ‘DR’ (1). The second one is the backup of ‘SR’, which allows the calculation of distances ‘DBSR’ (2) between terms in each part of the course. The third one is to offer the possibility of the fusion of the fragments found after research, filtering and selection.

The fusion can take place in the two following cases: the fusion of one or more Web resources and the fusion between sub fragments in the same Web resource. In these two cases, we can find sub fragments in several places in the Web resource. There are two different levels of extraction (as in Fig 4.): (1) fragment level which is based on ‘DP’; we apply the method in the first time on all Web resources to find the most relevant for the course as in the example “D1, D2 & D3 are three documents in Fig 4.” After that, we apply the method ‘DP’ for another time for all most relevant Web resources to extract the most relevant fragments as in the example “F1, F2 & F3 of D1 in Fig 4”. (2) sub fragment level that’s based on ‘DBSR’ which presents distance between words of Web resource sub fragments are compared with terms of SRs. We apply method to all extracted fragments to extract the most relevant sub fragments and then we have just associated the green ones to correspondent SRs as in the example sub fragments 1 and 2 are selected “SF1, SF2 & SF3 of F1 of D1”. As a result, we have extracted three sub fragments: D1F1SF1 / D1F2SF1 / D1F3SF1 of Semantic rule one ‘SR1’ in part one ‘P1’; part one of course contains four SRs, the first one has three most relevant sub fragments, and among these three ones we must choose D1F1SF1 (Sub Fragment one of Document one). After that, we have selected sub fragments with bold color to get components of each part of the course. Results are saved in ‘NFDB’ database. We can illustrate the process of that fusion by using this example: Fusion of three most relevant fragments in three different documents to the same part of the course (as in Fig 5.). In this example, we have selected from ‘NFDB’ database sub fragments which have been associated to SRs. There are three parts of the course which have different colors (Blue, Red and Yellow).
(4): Construction of Learning Domain

After the process of fusion, we get all sub fragments which are saved in ‘NFDB’ database (as in Fig 4.). For this ‘NFDB’ database presents our Learning Domain ‘LD’. ‘LD’ can also be adapted to learner profiles, because our pedagogical ontology is based on semantic rules defined in ontology of domain, that is why each sub fragment extracted from Web resource is associated to one SR which gives us one part of the course. We will mark the process of adaptation in the next part of the paper (Adaptation to Learner’s Profiles).

(5): Adaptation to Learner’s Profiles

At this moment, we have not a learner model but after that we can use its outputs (learners’ level). We have created a method which is based on learners’ test. Through this method, we can determine the level of each learner. In addition to the creation of a pedagogical ontology which may be used when we have a learner’s level. In our approach, we have enriched pedagogical ontology with same semantic rules defined in ontology of domain, but grouping the SRs in levels; that is to say, each level has some numbers of parts of the course, and each part has some numbers of SRs associated with it. When the level of learner increased, the numbers of parts increased too (as in Fig 6.). At the end of our work, we will reach the realization of the Adaptive Learning Domain from Web resources.
We have associated each 'SR' for one level like (SR1 L1: Semantic Rule N°1 is associated to Level N°1). And for each part of the course, we have to associate each SR to only one level as in this example: (P1 “Part of course N°1” contains four (04) ‘SRs” “SR1 L1, SR2 L1, SR3 L3 & SR4 L3”). With the fusion of different 'SRs' of one level or multiple one, as consequence, we can get sub fragments of learner’s level. Level number one is composed of three sub fragments “D1F1SF1 (Sub Fragment one of Fragment one of Document one), D1F2SF2 (Sub Fragment two of Fragment two of Document one) & D2F1SF3 (Sub Fragment three of Fragment one of Document two)”. The extraction of sub fragments is based on fusion process that is explained in the precedent part of paper.

**Evaluation of PrOALDoF-Web System**

We have two points: Items of comparison and Results of Comparison.

(1): Items of comparison

We have 14 points or items to evaluate the quality and usefulness of our approach. To get more benefit, we have compared PrOALDoF-Web with three ways of courses’ creation: manual creation by authors, creation of courses in E-Learning platforms by authors and the tools of creation. The last one can be divided into two groups: Commercialized Platforms (MOODLE …Etc.) and recent researches in E-Learning Platforms. We have obtained 9 items from the Learning Object Review Instrument (LORI 1.5) that is an evaluation framework for multimedia
In our study, we have three methods of courses' creation "Manual, Semi-Automatic and Automatic method".

(1): **Manual Method**: used directly by the authors, they seek information in a domain, using different methods and engine of research to choose the most relevant information in different resources of it (Internet, books, papers ...Etc). The authors must filter results in order to create their own course in electronic format (Word, PDF or another format).

(2): **Semi-Automatic Method**: There are two sub categories: Assisted Method and Dynamic Method

- **Assisted Method**: a method which can be assisted by an author, using tools of courses’ creation such as: LMS "Learning Management System" or LCMS "Learning Content Management System" that are available in the training platforms as: (Moodle, Sakai, dotLRN, OLAT, Olat LMS, OLMS, ...etc). There are also other ones such as: free software (Adobe Coursebuilder, CALI Author, CourseLab, eXe, AuthorLCDS, Learning Content Development System, Lesson Writer, Memorize, MOS Solo ...etc.) or commercial software (Adobe Captivate, Articulate, Camtasia, Composica, Outstart Trainer, OpenWorld Presenter, PowerTrain Authoring Tool ...etc.) which are available in the market. In these cases mentioned above, authors must search for information and filter results and extract the most relevant information to fill all fields in process’ creation.

- **Dynamic method**: following the pedagogical aspect to formulate bricks of information that are previously created by authors through proposed model to achieve the goal which is the adaptation of courses to learners' profiles. Here, there are examples which can illustrate the recent research works, among them there are those proposed approaches based on: ontology, multi-agent systems ... etc.
(3): Automatic Method: Through PrOALDoF-Web system that offers an approach which eliminates the lack in the first two cases (Manual and Semi-Automatic method). This lack can be found in the search and the filtering of information when the course is being created. Moreover the approach provides an opportunity to increase the quality of courses by combining different resources, and then gives the advantage of adaptation of content to learners’ profiles according to the proposed approach for the desired target.

(2): Results of comparison

We evaluate the proposed approach. Firstly, we have validated ontology of domain with three specialists. Secondly, series of experiments and analyses were performed. At the initial stage of the project, the evaluation was on author perceptions and reactions towards the system and its proposed functions of fusion of Web resources and the adaptation to learners’ profiles. After that, the proposed approach has been properly implemented to the efficiency of that system. Then the evaluation was on learners’ perceptions and surveys about system. 127 students and 17 teachers from University of Annaba - Algeria have participated in this evaluation by using the JAVA PrOALDoF-Web system. The results of students are as follows: 84.25% of satisfaction, 12.59% of dissatisfaction and 3.14% which are other views. In addition to, the results of teachers are as follows: 76.47% of satisfaction, 11.76% of dissatisfaction and 11.76% which are other views. The evaluation is related to the levels of comparison that are detailed in table 5.

Table 5. Levels of Comparison

<table>
<thead>
<tr>
<th>Points of Comparison</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Method of creation, Enrichment method, Content Research</td>
<td>Manual</td>
<td>Under</td>
<td>Medium</td>
<td>Over</td>
<td>Automatic</td>
</tr>
<tr>
<td>Ease of Use, Experience of Authors, Content quality, Feedback and adaptation, Learning goal alignment, Motivation, Presentation design, Interaction usability, Accessibility, Reusability, Standards Compliance</td>
<td>Low</td>
<td>Under</td>
<td>Medium</td>
<td>Over</td>
<td>High</td>
</tr>
</tbody>
</table>

Table 6 provides a comparison with PrOALDoF-Web in automatic way and with different methods of courses’ creation by authors in manual way (C1, C2 & C3 in table 6 present three courses of three different authors) or with authoring tools in semi-automatic way. Number one to five ‘1...5’ of each column in Table 6 is explained in Table 5.

Table 6. Results of Comparison

<table>
<thead>
<tr>
<th>Points of Comparison</th>
<th>Tool of Creation</th>
<th>Our Approach PrOALDoF-Web (Automatic way)</th>
<th>Manual creation (By Authors)</th>
<th>Creation of Course in E-Learning platforms (By Authors with tools’ creation)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Method of creation</td>
<td>5</td>
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Method of creation, Enrichment method and Content research are three different points of comparison. These three points work automatically in PrOALDoF-Web. The first interest of our approach is to create courses directly from Web resources and to save time. The strategy has allowed to add other sub fragments in database, for the reason that
our main goal is to find for each part of the course a list of pertinent documents from the Web, and the content of course will be created from the extracted sub fragments which have a perfect relevance. However, in the other methods, the three different points of comparison which are mentioned above work either manual or semi-automatic. These previous ways of creation can take much time when it's purely manual, in contrast to using tools' creation through which time can be saved.

Ease of use, Experience of authors and Content quality: In our system and in the most last researches about tools' creation, the use of these different components is easier, each part of the course can be controlled and validated by experts of domain who have enough experiences, as consequence courses may have higher quality.

Feedback and adaptation / Learning goal alignment / Motivation: are three different points of comparison. In our system, the adaptation is assured by the approach which is based on fusion, because we have the goals which are defined in pedagogical ontology for each learner and the content that can be used in creation of courses is stored in ‘NFDB’ database. In the most last researches about tools’ creation, experts have proposed approaches which can do the adaptation which cannot be done by the other tools’ creation. In the first cases above, the systems have a specific ability to motivate and interest learners.

Presentation design and Accessibility: The two points of comparison have not been completely assured by our system; they can also perform a future enrichment in this field. There are many works in this area where researchers have given the quality of presentation design and satisfied accessibility in platforms for learners. Those two points of comparison cannot be done manually.

Interaction usability, Reusability and Standards compliance: are three different points of comparison. In our system and in the most last researches about tools’ creation; the navigation in system is easier, the quality of interface is higher. In addition to a help that can be used by learners. Systems can be used in varying learning contexts for different learners. These two precedent cases of creation assure the international technical standards and specifications. Those three points of comparison cannot be done in the other tools’ creation.

To better understanding the results of comparison, we have made the diagrams of the six cases about courses' creation with the 14 points of comparison (as in Fig 7.).

Figure 7. Diagrams of the different methods of courses’ creation
Discussion and Conclusion

The results of evaluation reflect the success of PrOALDoF-Web system talking about the performance of items in comparison with our system and different methods of courses’ creation (methods which have been mentioned in our work). Through the study which was carried out with: (Research, Filtering and Selection) of Web resources, Fusion of sub fragments and Adaptation. All those steps that are cited, they have been used in order to construct an Adaptive Learning Domain that can be adapted according to learners’ profiles. This study gives us a complete system of courses’ creation and the adaptation of courses which are designed for learners. The proposed approach has offered new techniques which have made the Web as a medium of resources which are well organized and adapted directly to learners’ needs. Adaptation of extracted Web resources gives reliability, satisfaction of learners and content quality in E-learning platform. This approach doesn’t need many efforts and much time which can be done and taken by authors to create courses which can get a high quality because their contents are obtained from the large richness of Web. The update of courses is done directly from the Web with the reusability of the extracted resources.

Through this presented research, we have achieved the idea that the different methods of courses’ creation which cannot be assured automatically, because those methods offer either interfaces where authors can download their courses or tools which give texts zone that must be filled by authors who are implicated in such creation and they have their own scope of research about resources in the Web (search engines, online libraries, sites of universities ... etc.). Therefore, authors should provide great effort to filter resources and extract the contents which are needed for their courses. PrOALDoF-Web is completely based on Web for the objective to create courses in automatic way using ontology of domain and semantic rules which may present some difficulties in their manual creation, because for each fragment of course we create an important number of SRs. This step needs more efforts by experts. The efficiency of the approach will be improved when the number of SRs increased. For that reason we have to look for an automatic creation of SRs.

References


