

Issues of E-Learning Search Engine and its Challenges

Kamal EL GUEMMAT¹, Sara OUAHABI²

¹Laboratory of Information Processing, Faculty of Sciences Ben M'Sik, Hassan II University, Casablanca, Morocco.

²Modeling and Information Processing Laboratory, Faculty of Sciences Ben M'Sik, Hassan II University, Casablanca, Morocco.

k.elguemmat@gmail.com, sara.ouahabi@gmail.com

ABSTRACT

Search engines have enough benefits in many fields such as business, trade, health, tourism and so on. In the e-learning systems search engines can be applied to the regular teaching and education, higher education, initial and continuing training. Given the issues and challenges of e-learning search engine, students, teachers, administration, and other participants may find themselves in a position in which they can further develop this type of search. This paper presents the opportunities of search engines; however, the attention will be on issues and challenges related to e-learning search engine and their characteristics that we have deduced following an interesting selection method of papers, an analysis and a precise comparison between the benefits and challenges of search engine-based e-learning with their difficulties. Thus, we proposed several suggestions and eventually a policy to be taken into consideration by educational institutions to make these engines more efficient. This paper will lead an important overview of the progress of search engine-based e-learning for the educational institutions.

KEYWORDS

search engine, e-learning, issues, challenges, policy, educational institutions.

1 INTRODUCTION

The search engines are concerned in finding from a large corpus, relevant documents (image, text, video, web page etc), responding to the user's request. It's the name of search systems in the advanced computer field and in

information management, their profits interact with other fields. Search engines are a whole of techniques that provides access to relevant information. Search engines currently use indexing and searching techniques to find pertinent documents. In practice is the development of directories with more advanced and more intelligent systems to increase search performance. Robust search engines help in finding, sharing, merging documents using local networks, cloud computing and internet tools.

The e-learning systems also interact with educational applications of search engines, these applications help e-learning actors (students, teachers, administration, and other participants) to annotate, find and use learning object (LO) [1], [2]. This interface provides several benefits in e-learning systems such as search of information from courses, the sharing between actors, searching guided by assistance, minimize the time of the preparation of indexing and the outputting of knowledge's searching models [3].

The challenges and issues are one of the major concerns for performance or arrears of search engines baptized by the automation technology of information processing. Search, explore, reuse, annotate, assist is the wonderful gift of e-learning search engines, but the problem is that these benefits have enough challenges to shape either in the metadata, semantic search, reusing and searching by assistant. Other difficulties such as interoperability, automation, hidden and multimedia LO influencing the performance of the usage and exploitation of e-learning actors.

Thereby, the main purposes and objectives of this paper include:

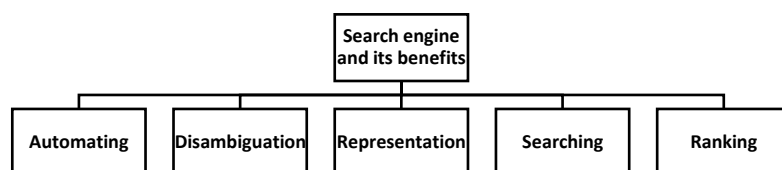
- Examine the search engines and their benefits.
- Discover the e-learning search engines their issues and challenges; Evince several effective examples.
- Get research findings.
- Propose suggestions and policy.

The next section presents significance and benefits of search engines in general and in e-learning systems; thereafter is the section that explains the method used to select the papers cited in this paper; this section is followed by benefits, difficulties, challenges of e-learning search engines as well as findings, suggestions and finally there is conclusion.

2 SIGNIFICANCE AND BENEFITS OF SEARCH ENGINES

The search for the information dates to 1948 [5]. Mooers worked on this subject for the first time in his master's thesis. Several definitions of search information have been defined [3], [6], [7], [8], [9], [10], [11], [12] to describe the search as a process of how information is deposited, ordered, characterized and easily available to the user.

This topic has assumed great importance in the scientific community, it yielded several impressive results [13], [14], [15]. Figure 1 shows several advantages of search engines that help examiners humans to quickly identify where find the interest information;



represent the document (respectively the request); help users find and use information effectively; provide multiple indexing models (manual, automatic); provide access to lots of information and make precise searches (using boolean operators, truncation etc) with ergonomic interfaces and an ease of use; rank results; find the correct meaning of each word in the document (respectively the request); match the need for information with those of the database.

Figure 1. Benefits of Search Engine

Most learners use general search engines including several varied disciplines to find LO related to their studies, but it seems less useful because of the time and effort that students must spend to find items related to their learning requirements and favorites. Universal search cannot and probably should not meet the precise needs of disciplines [16] the need for enhancement is an important challenge in this case [17].

As shown in figure 2, the e-learning systems interact with educational applications of search engines to overcome the boundaries of the general search.

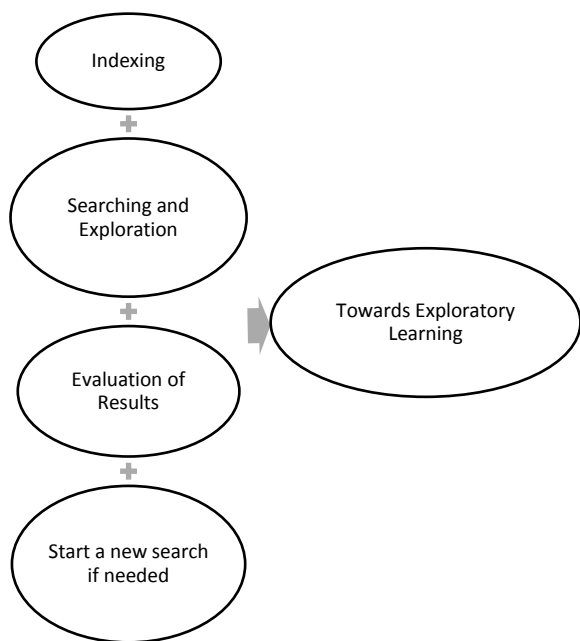


Figure 2. Structure of an E-Learning Search Engine in Brief.

In the case of e-learning systems the search engines used are inspired by exploratory learning approach [4] which allows students according to search and indexing mechanisms to direct their own scholarship. Through the process of discovery, or guided discovery thereby the student learns the facts, concepts, and procedures. E-learning search engines offer many profits, but it offers so many difficulties and interrogations that are critical to support.

3 THE RESEARCH METHOD

Since their commencement, search engine-based e-learning have been extensively studied by researchers.

Considering the massive number of papers existing, it was decided to reference a sample of the significant literature in this paper.

Most papers were selected for study if they were relevant, using some questions as criteria for inclusion or exclusion:

- Is the search engine compatible with e-learning technology?
- Was the article published recently or formerly?

- Is the setting are pertinent for the efficacy of search engine and e-learning for educational institutions?
- Do the researchers present enough background, are the results replicated?
- Is the article interesting in the field of search engine and e-learning research?

Thereby, papers that are supported, are from recognized scientific databases. We have selected papers published in recognized proceeding of international conferences and in recognized international journals.

For dates of publications we tried to be opened on the old and recent publications, to provide a rich and comprehensive study, knowing that the old publications contain the fundamentals of science and recent publications contains the latest results and advancement of technology.

After the selection of papers, the most important features of educational search engines are divided into two parts. the first part contains the benefits plus challenges, and the second contains the difficulties.

Other features that relate more to learning management systems (LMS) are not covered in these parts such as technical, infrastructure, platform and service aspects such as IT security and other characteristics.

We then compared the benefits of search engine-based e-learning with their difficulties following tables that will be presented after to getting research findings and propose solutions.

4 BENEFITS AND CHALLENGES OF E-LEARNING SEARCH ENGINE

The search engine provides several benefits in e-learning by using metadata [18], semantic indexing [19], reusing and search by assistant technologies. With the help of search engines, the searching and exploration of LO is easier, aspects such as assisting, navigation, sharing, reusing, and adapting of LO is also possible.

However, there are still challenges to overcome to make these engines more efficient.

4.1 Metadata

Today metadata standards [20], [21] allow indexing, location and reusing of LO. An exploratory study was conducted by [22] reveals that the LOM-base search offers plenty of opportunities and a real advantage over search based on the resource's content. Another example explains how actual software systems apply these metadata to simplify the location of LO, especially in the case of the brokerage service for LO [23].

In addition to the previously cited features, some e-learning systems permit navigation of their collections but there are others who are unable to organize a course tailored to the specific learners, because relationships between all LO are not clearly defined and the real goals of the users are difficult to recognize. The case study of [24] affirm that interfaces that have good definitions of these terms of usability, have proven a great advantage for the location of LO within the navigation scheme, and therefore have allowed us to know the classified structure to continue with the exploration process.

Another challenge could come from these standards is that they focus much on the technical aspect and neglect the educational information related to the real use of LO in the context [25].

The automation of metadata generation is an important advantage for e-learning systems. Search engines index LO automatically without manual intervention of the users, making metadata generation easier in a shorter time. In this context, the system proposed by [26] allowing the automatic extraction of semantic metadata from a specific sub-set of LOM metadata.

The challenge of this kind of systems is the quality of the annotation, sometimes the manual value is better, sometimes the automatic value is better [27]. Automatic generation of pertinent metadata for LO is still a very difficult problem, and currently a hot topic. The fact that the related educational information depends in large extension on the context and the information generated

automatically fill only the simple fields who have low value.

4.2 Reusing

Support adapting and fragmentation of LO is another advantage for search engines. A LO is an entity that we can find, share, reuse, and adapt it in a learning process assured by technology [28], [29]. According to Wiley [30], with small units of LO well indexed, we can lead to a faster and more efficient creation of new LO. The main objective of creating learning objects is to build fragments of course or small parts that can be used and reused in different learning contexts. For example [31] presents KnowledgeTree, an architecture for adaptive e-learning based on distributed reusable intelligent learning activities. It provides answer content queries – listing search results: activities that match a specific description (in terms of metadata) or provide all known metadata for a specific activity. It provides also the ability to launch an activity by direct request. Therefore, we reduce the production cost of LO and the expertise to produce it.

The challenge of this system is the need to find an agreement on what constitutes exactly an LO. There are many definitions, some so large they consider LO as anything at all [32]. In the broadest sense, a learning object is anything that has an educational purpose [33]. In this case it necessary to find, analyse and refine LO manually before reusing it, what will generate enough worries.

4.3 Semantic

More importantly, semantic search engines overcome the problems that have been posed by classical search engines [34]. Two major benefits of this transformation; the first is that the LO presented in search results have a semantic relationship with the requirement. We will mention three cases which have been able to affirm this statement [35], [36], [37]. These search engines are well evaluated according to the precision, recall and f-measure measurements. The second benefit is

the deduction of the appropriate semantic context for the search [38].

However, two major challenges facing this type of search engine; the first is that the studies of usability of these search services reveal that are not easy to use [39]. The second challenge is that the reasoning modules based on the inference engine technologies may not be valid in all potential uses [40].

4.4 Assistant

The last advantage that will be cited is the search engines by assistant that presents a user-friendly interface to guide the user in the description of the LO and provides other useful features such as the advanced search, automatic translation of terms, recommendation of terms, reduction the time of search, grouping of search results, follow students, implementation of many visual and cognitive aids, detection of misconceptions and the proposal of LO to overcome them.

According to search assistant proposed by [32] success in finding learning objects by study participants went from 80% using Google alone to 96% when using their search assistant in one scenario and, in another scenario, from a 40% success rate with Google alone to 66% with their assistant.

It is important to note that users tend to have difficulty to choosing the proper keywords [41]. Help users to find relevant LO is an area that needs more attention. The importance of such encouragement becomes clear in e-learning [42]. Search engines should be simple and smart enough to detect the favorites and requirements of students [43], [44], [45].

5 DIFFICULTIES OF E-LEARNING SEARCH ENGINES

It is important to note that an increasing difficulty appeared to search, manage, and classify LO for an e-learning environment [46]. Among the main factors influencing the performance of these engines there is the concern of indexing and searching interoperability, manually indexing, searching

of hidden LO, indexing and searching of multimedia LO.

5.1 Interoperability

For the difficulties, we start with interoperability which refers to the implementation of LO in different learning and content management systems and how to plug and play it easily in different platforms. Interoperability is defined as the creation of a semantically compatible information environment based on the agreed concepts between different entities [47]. Providing interoperability among heterogeneous e-learning systems is one of the main issues in creating a distributed e-learning systems and federated e-learning systems. This difficulty is due to the technical difference between these systems, the difference exists in the indexing and searching methods especially when trying to determine semantic meaning; The same data value can have different meanings from one e-learning system to another. Although [48] identified the interoperability gap that exists between Learning Object Repository (LOR) and Learning Management System (LMS), there remained many unanswered queries by their search. Another issue which concerns interoperability between e-learning systems is that have heterogeneous interfaces that are not easy to use [48], [49] aptly observed, "It is clear that some sort of interface between the two components (LMS & LOR) is required to enable a system to benefit from the other one." [50] define the problem in two points; the first problem of the LO paradigm is the incoherence in the metadata. This incoherence is due to the fact that the labelling process, which is basically done by hand, generates documents with serious shortcomings, including many deficiencies related to the lack of key attributes in the description. This makes it difficult, or impossible in some cases, to study this aspect. The second problem is the heterogeneity of the repositories and their malfunction. The proposed system by [50] tries to minimize this second problem.

5.2 Manually

We now turn to the manual generation of reliable metadata that still a very difficult problem and is currently a hot topic in the Web 2.0 movement. In many learning management systems, metadata can be associated with learning objects manually, or they can be generated partially by the system. Manual creation of metadata might be feasible in small deployments, but that it is not an option for larger deployments where a considerable number of LO must be managed for each user. The system should offer functions comparable to search engines and classifiers for the web. Search engines must index LO automatically without manual intervention of the users or the creators of the LO [27].

5.3 Hidden LO

For the penultimate inconvenience, it is the hidden LO. There is a large mass of LO in e-learning systems unreachable by the available search engines. These LO are called hidden, deep, or invisible opposite to LO found in the search engines available. The techniques developed for conventional search engines are very effective in the search for visible LO. The method of crawling used by search engine uses a centralized discovery technique that can be applied to LO visible by crawlers. This technique cannot be applied in a deep environment where LO are accessible by techniques adapted to specific sources. However, some e-learning systems can be difficult to find and share their LO, while others are not available to the public. Also, e-learning systems has a challenge to retrieve LO; an example would be LO that is stored in LOR databases [51] or search engine that place LO that is irrelevant for the educational topic ahead of the relevant LO, the LOs become hidden or not easily discoverable.

5.4 Multimedia

The last difficulty that will be cited is the Multimedia LO. Regarding the multimedia indexing is often treated as the inverse of the creation process. A film is based on the actions of the writer, director or editor who are guided by the need to create a narrative and physical characteristic of the media used. This structural approach is basically developed to offer search applications by content. These descriptions are not only a way to attach information to different levels of audio-visual document contents, but they also help define organizational structures of the documents on which applications can be rest on. However, the metadata generated for Multimedia LO cannot be effective for semantic search engines. The work proposed by [52] describe and evaluate a new approach to generate a semantic annotation for multimedia resources; unfortunately, the quality of the annotation is not as good as if it were done by a human.

6 FINDINGS AND SUGGESTIONS

So far, there has been a significant literature on e-learning search engines. In this section we will summarize them in two tables to abstract, analyze and compare the benefits and difficulties of these engines.

The first table (table 1) contains the benefits offered by e-learning search engines. Firstly, it gives the advantages offered by metadata to improve indexing, location and reusing of LO [22], [23], enabling navigation [24], creating relationships between LO [20] and automatization of indexing [26]. Secondly, it gives the advantages offered by the reutilization like support adapting [28] and the capacity of course's fragmentation [31]. Thirdly, it gives the advantages offered by semantics such as improving semantic search engines [35], [36], [37] and the capacity of reasoning [38] and in the end it gives the advantages offered by the assistant that help users to find LO [32], [42] and to detect the preferences and needs of students [43], [44], [45].

The second table (table 2) contains the difficulties posed by e-learning search

engines. In the first place, it gives the difficulty of interoperability especially between federated e-learning systems that has difficulties to support technical heterogeneity [47], [48], [49], [50]. Secondly it gives the problem of manual indexing and that enormous efforts are needed for obtaining great value [27]. Thirdly there is the difficulty of hidden LO and that E-learning systems has a challenge to retrieve Hidden LO [51] and finally it gives the problem of multimedia LO because the quality of the generated Metadata is not as good as if it were done by a human [52].

By analyzing prior research on this technology, we can compare the benefits of e-learning search engine [20], [22], [23], [24], [26], [28], [31], [32], [35], [36], [37], [38], [42], [43], [44], [45] as shown in table 1 with their difficulties [27], [47], [48], [49], [50], [51], [52] as shown in table 2 as well as getting research findings and propose solutions.

Table 1. Summary of E-Learning Search Engine Benefits

Benefits	Reference
Metadata [18]	
Improve indexing, location and reusing of LO	[22], [23].
Enables navigation	[24].
Creates relationships between LO	[20].
Automatization	[26].
Reusing	
Support adapting	[28].

Enables fragmentation of course	[31].
Semantic [19]	
Improve semantic search engines	[35], [36], [37].
Enable reasoning	[38].
Assistant	
Help users to find LO	[32], [42].
Detect the preferences and needs of students	[43], [44], [45].

Table 2. Summary of E-Learning Search Engine Difficulties

Difficulties	Reference
Interoperability	
Federated e-learning systems has difficulties to support technical heterogeneity	[47], [48], [49], [50].
Manually	
High effort for obtaining great value	[27].
Hidden LO	
E-learning systems has a challenge to retrieve Hidden LO	[51].

Multimedia

The quality of the generated Metadata is not as good as if it were done by a human

Search engines bring several benefits to e-learning systems, but at the same time face enormous difficulties and shortcomings hindering their development which adversely affect the performance of e-learning actors. By focusing on the positive and negative points and filtering what we found, we could draw some ideas to achieve optimal coupling search engine and e-learning.

6.1 Findings

Several benefits, difficulties and challenges could be found; which will be summarized in the following.

The search engine provides several benefits in e-learning by using metadata, semantic indexing, reusing and searching by assistant technologies. However, there are still difficulties and challenges to overcome. For example, metadata focus much on the technical aspect and neglect the educational information related to the real use of LO in the context [25]. Also, the metadata generated for Multimedia LO cannot be effective for semantic search engines [52]. Metadata creation is another difficulty; the manual creation of metadata demands high effort for obtaining great value otherwise automatic indexing of LO fills only the simple fields that do not have great value to add [27].

On the other hand; some e-learning systems can be difficult to find and share their LO thus the LOs become hidden or not easily discoverable [51] and the reasoning modules based on the inference engine technologies may not be valid in all potential uses [40]. Better search and reuse of LO reduces the production cost and the expertise to produce it, the challenge of this system is the need to find an agreement on what constitutes exactly an LO [30]. On another side, distributed e-learning systems suffer of enough worry such as interoperability [47], [48], [49], [50].

Additionally, general search cannot and probably should not meet the specific needs of disciplines [16]. Success / relevance of search occurs when the intelligence of the questioner of search engine match the intelligence of those who designed it and when the assistants search increasing the level of help and navigation between LO and reduce the number of returned LO [32], [42].

6.2 Suggestions

Instead of a classical or general search which includes enough disciplines diversified; e-learning actors should go for specialized searching; integration of knowledge and domain of understanding is essential in the recovering, indexing, presentation, searching, classification and reusing of LO. For example, educational institutions can develop search engines dedicated to LO and encourage their e-learning actors to use it instead of the classic or general search engines that appears in the Web. In the literature, there is enough technique of metadata, semantic indexing, semantic searching and reusing of LO. Each educational institution can adopt a technique as required.

Concerning the deduction and the reasoning on LO; is a very interesting topic deserves further examination and research. The educational institutions can take into consideration these techniques the deduction allows us to detect the appropriate semantic context for the search to involve the users. The educational institutions must be careful in the choice of technique since the reasoning modules based on the inference engine technologies may not be valid in all potential uses. Otherwise must propose their own techniques.

Another suggestion is that the assistants search need leverage the description of the LO to arrive to queries that provide accurate search results. There are several assistance techniques for search engines. The educational institutions can adopt these assistance techniques to make search simpler and more efficient; For example, can begin with the proposal of the user-friendly interface to guide the user in the description

and the search of the LO, and subsequently accompany this step by automatic translation of terms, suggestion of terms, reduction the searching time, grouping of search results, follow students, implementation of many visual and cognitive aids.

For unification of the indexing, searching, reusing approaches for standardize the field of e-learning search engines need be introduced. For example, educational institutions can go for national and regional federated e-learning systems while maintaining interoperability and availability of LO to integrate.

For the latest suggestion; instead of manual method, automate the indexing of LO, especially multimedia LO, appeared to be the successor of the manual one; a new document automatically indexed, will be searchable and verifiable with a minimum of work. But what appears is that sometimes the automatic value is not better than manual and in most cases the information generated automatically fill only the simple fields who have low value. Educational institutions can benefit of advantages of automatic indexing techniques. So, it is necessary to think of a compromise between manual and automatic indexing which can be for example the techniques of semi-automatic indexing.

Educational institutions can benefit from the different recommendations which are mentioned before and prepare a policy specific to their context.

But in general, we suggest a policy as follows:

- Adopt automatic and hybrid indexing, combining and benefiting from different techniques, classical, semantic and by metadata [18] [19] [26].
- Adopt methods of interoperability within the institute and with other partner institutes [50].
- Adopt exploratory search methods [53].

According to the different comparisons that are made, the issues and challenges elevated; the careful adoption of this policy will give a

lot of progress to the search engines of the educational institutes.

7 CONCLUSION

This paper presented issues and challenges related to e-learning search engine. This last offer many benefits, but it offers so many difficulties and questions that are critical to support in the future research. E-learning may also benefit from search engines that provide many opportunities and plays an important role for overall IT infrastructure development. Searching, exploring, reusing, annotating, assisting is the wonderful gift of search engines. These benefits have enough challenges to shape either in the metadata, semantic searching, reusing and searching by assistant. However, these search engines still have enormous difficulties such as interoperability, automation, hidden and multimedia LO influencing the performance of the use and exploitation of e-learning actors whether students, teachers, administration, and other stakeholders. At the end of this article we proposed several suggestions as well as a policy to remedy these various difficulties. There are still some limitations in this study which will be dealt in the next studies, we quote for example the lack of issues and challenges of the technical aspects of implementation of these e-learning search engines. We quote also the deep relationship between these engines with LMS and other aspects such as cloud computing, big data, IT security.

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