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Integration of Open Educational Resources Using Semantic Platform

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ABSTRACT Universities around the world have been taking advantage of open educational resources (OERs) for publishing educational material. The teachers and students can access, the published material for teaching, learning and research through institutional repositories. This article proposes the design, construction and validation of the semantic platform (MIIDAS), considering two case studies of higher-level educational institutions (civil and military schools). The MIIDAS Platform integrates educational resources in institutional repositories related to the areas of Computing and Electronics engineering through the incorporation of Semantic Web technologies. The descriptions of resources consider metadata of the OAI-PMH protocol and also add educational metadata. The platform uses RDF resource descriptions, ontologies and the SPARQL query language to improve resource retrieval, in addition to proposing guidelines for the management of educational resources. The results of validation of the platform are presented through the development of evaluation instruments, which suggest possible ways to improve the platform. The article provides the basis for developing platforms that help in spreading open educational resources and allow the construction of semantically enrich data sets.

INDEX TERMS Application software, educational technology, open educational resources, repositories, semantic technologies.

I. INTRODUCTION

Open Educational Resources (OER) are defined as any teaching, learning, or research material that are released under open license that permits no-cost access, use, adaptation, and redistribution or with limited restrictions [1]. Several initiatives have emerged such as: Budapest [2], Bethesda [3], and Berlin [4] that encourages universities to share their published resources online.

The openness of OERs does not only refer to the free access to consult, enrich or generate new resources, but also to an open structure (semantic indexes) in a processable format Resource Description Framework (RDF) belongs to the technologies of the Semantic Web, based on ontologies, semantic descriptions (semantic indexes), and languages [5].

The use of these technologies in educational institutions allows the end-user to dynamically recover the educational resources generated by the teachers and students in a short time; in addition to promoting dynamic activities among the main personnel in the teaching-learning process [6].

This article aims to solve the following problems related to the management of OERs: (i) To propose a methodology that allows educational institutions to guide in the process of creating its institutional repository, considering semantic technologies, (ii) Lack of inclusion of educational metadata that allows describing the resources, such as: associated teaching approach, driving model, and learning style, (iii) The impact of inclusion of semantic technologies in the repositories to enhance resource recovery and improve user experience perspective.

Previously, at the Universidad Autónoma Metropolitana, Iztapala (UAM-I), a research work has been carried out the development of instruments to detect information required by students and teachers. Six different ontologies have been created, i.e.: Educational (OntoEduca), Educational Resources (OntoRE), domain (Computing, Electronics and Military)

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and user profile. Moreover, the MIIDAS approach-based methodology helped to guide the design and implementation of the platform.

This article uses the semantic platform to integrate OERs considering different stages of the MIIDAS Methodology. The proposal was put to the test in two higher educational institutes in areas of Computing and Electronics engineering, and the results were satisfactory. These scenarios were considered from the detection of needs to the evaluation of the platform in which more than 100 students and teachers participated. The evaluation of the platform was carried out through two usability instruments (rubrics) that consider criteria of repository work and open educational resources; as well as educational applications.

This work aims to provide a platform that will help or guide educational institutions to create and share their educational resources from the perspectives of institutional repositories and semantic technologies.

The article is organized as follows: Section 2 presents the literature survey of the problem. In section 3, the development of the MIIDAS Platform is explained. Section 4, describes the platform and the instruments designed to perform the validations. Section 5, presents the results obtained in the case studies. Subsequently, section 6 shows the discussions. Finally, section 7 presents the conclusions and future works.

II. RELATED WORK

Regarding the proposals and frameworks that recommend the inclusion of linking open data repositories, Piedra *et al*. [7] present a framework interoperable data considering metadata that helps to share collections of open materials deposited in repositories. Similarly, LOD4AIR [8] proposes a strategy to produce and consume linked open data (LOD) from OAI-PMH standard (Open Archive Initiative Protocol Metadata Harvesting) [9] that are considered by the repositories.

Several research works have been carried out for integrating semantic Web technologies to improve the recovery of resources, Shah in [10] used semantic technologies for the development of a support system for the recommendation of material based on student demand; as well as the background and preferences in order to find teaching material effectively. In [11] the design and implementation of an application aimed at providing services in a library is presented, through content enriched by linked open data in an institutional repository. In [12] it is shown that it is possible to collect academic resources from several repositories of open educational resources (OER) in a federated way; in addition to automatically annotating the standard thematic terminology to the ontologies. In the reference [13], Sterman and Borda describe the reasoning and the process used to develop a visual representation of three levels (considering metadata of university, departments and year) of a collection of electronic thesis and dissertations for an easy and interactive discovery allowing users to understand large amount of information.

The design and implementation of a semantic web service in presented in [14], which retrieves thesis and extends the search based on keywords of a repository. It also contains the results of a survey that allows us to empirically explore usability.

Finally, some works that present a proposal to describe educational resources considering metadata and incorporating semantic technologies are: the work presented by Koutsomitropoulos and Solomou [15], which propose the improvement and maintenance of educational resource metadata in the form of learning object ontologies and introduce the notion of a learning object ontology repository to aid publication, discovery and reuse of the resources. Reference [16] compares two approaches for generating metadata considering the OAI-PMH protocol and the institutional repository DSpace to incorporate linked data. The authors Dorobăţ and Posea [17] show how to transform the description of resources in XML format (eXtensible Markup Language) contained in the DSpace repository to linked data considering cultural institutions.

III. IMPLEMENTATION OF THE MIIDAS PLATFORM

For the development of the MIIDAS Platform, the MIIDAS Methodology [18] was considered which consists of 6 stages: A) Detection of needs, B) Construction, C) Dissemination, D) Use, E) Evaluation, and F) Maintenance and evolution.

Similarly, the MIIDAS Methodology can be viewed as a proposal for the large-scale and interconnected semantic management of open educational tools. The semantics lie in the characterization of the existing resources within the educational institution through semantic indexes made up of three layers: (i) metadata (bibliographic and educational), (ii) content, and (iii) links. In addition to the representation of a domain of knowledge (educational resources, user profiles, educational, Computing, Electronics and Military), that contains concepts and restrictions allow users to share and reuse data.

For the construction of the MIIDAS Platform, two higher-level educational institutions were taken into account for case studies: (i) Universidad Autónoma Metropolitana, Unidad Iztapalapa, UAM-I (http: //www.izt.uam.mx/) considering Electronic, Computer engineering and Information Technologies fields, (ii) Escuela Militar de Ingenieros known as EMI (https://www.gob.mx/sedena/acciones-y-programas/escuela-militar-de-ingenieros) considering the students and faculty members of the Computer, Informatics Communications, and Electronics engineering.

The development phases of the MIIDAS Platform and its activities in a generalized way are described as follows:

A. DETECTION OF NEEDS

In this phase, an analysis of the Strengths, Weaknesses, Opportunities, and Threats (SWOT) of both institutions was carried out. In addition, questionnaires were designed for teachers and students in order to know the use of information technologies usefulness in the classrooms; as well as preferences in different technologies and subjects in need of educational resources to be able to design the platform.

TABLE 1. Subjects in need of educational resources for students and teachers of UAM-I and EMI.

Rol	UAM-I	EMI
Students	Introduction to Computing	Electronic
	Fundamentals of programming	Programming
	Storage algorithms and patterns	Digital systems
Teachers	Introduction to programming	Programming
	Networks computer	Electronic
	Digital communications	Programming languages
	Databases	Object Oriented Software Development

The questionnaires were applied by considering a representative sample and relative convenience of each educational institution, considered by the UAM-I and EMI samples of 88 and 54 students, as well as, 8 and 19 teachers, respectively.

It was also possible to identify the most attractive types of resources for students and teachers of both institutions, resulting in the following: exercises and practices had an interest of 63% while thematic presentations had interest of 39.8%, the above for students and teachers of the UAM-I. For EMI students and teachers, the exercises and practices had an interest of 63% and thematic presentations with 31.5%. The most attractive type of platform for query and retrieve educational resources was web applications ranked as the most appealing by 96 % of students and 97 % of teachers at both institutions.

According to the results obtained from the given questionnaires, the subjects in need of educational resources were obtained, results summarized in. Table 1 where the roles and subjects by institutions are shown.

B. CONSTRUCTION

The design of the MIIDAS Platform was specified based on different UML diagrams and applying the spiral model [19], since it was necessary to make different modifications at the level of interfaces, functionalities, and activities proposed at the beginning of the process.

To implement the MIIDAS Platform, different activities were established, among which the following stand out: a) definition of guidelines to create exercises, practices and thematic presentations; b) proposal of the semantic index; c) construction of ontologies (educational, user profile, educational resources and domain: Computing, Electronics and Military); d) design and architecture of the platform; e) implementation of the platform and f) unit tests, integration and configuration of the platform. The above activities are described in more detail in [5].

In general, the platform implements two types of architectures: (i) Web architecture and (ii) service-oriented architecture. Web architecture is implemented when a user (teacher and / or student) accesses the MIIDAS Platform through a browser and sends a request to the server, which processes and responds. The service-based architecture occurs when the teacher requests the MIIDAS Platform to upload a resource and through an interface manages to interact with the institutional repository, which is another independent system.

The MIIDAS Platform is implemented under the following languages and technologies: Java programming language, using Java Server Page (JSP) and servlets; likewise, as Apache Tomcat 8.5 application server, the PostgreSQL Database Management System in version 9.6, Apache Jena in version 3.14 and DSpace version 6.3. Figure 1 shows the architecture for the MIIDAS Platform; as well as the technologies proposed for the frontend (software that interacts with users) and backend (server side of platform that communicates between the database and the browser).

C. DISSEMINATION

For the case of UAM-I case, dissemination was carried out through the presentation of the MIIDAS Platform in the Postgraduate seminars in Information Sciences and Technologies, where students and teachers were invited to participate and use the said platform, as well as, by means of email where invited to test the proposal.

In the case of EMI, the platform was presented at a meeting to the institutions heads department and teachers, where the activities and purpose of the platform were presented. The training of the use of the platform was individual to the teacher.

D. UTILIZATION

For this phase, in the UAM-I case study, the use of the platform was coordinated with the teachers of the subject of Analysis and Design of Computer Systems, where there were a total of 35 students. In addition, 9 teachers used the platform.

For the EMI case study, the use of the platform was coordinated with the teachers of the subjects of Distributed Systems and Programming, where there were a total of 39 students. Additionally, 29 teachers used the platform.

In two case studies, both teachers and students used the platform for a month.

E. EVALUATION

For the evaluation phase, two rubrics (evaluation instrument) were designed to validate the MIIDAS Platform.

The first rubric was designed considering the work of educational software [20] and usability of mobile learning objects [21]. This rubric was made up of 16 criteria grouped into the following four different sections: structure and presentation, efficiency, usability, and pedagogical dimension. The rating scale for this rubric was given from 1 to 5 for each of the criterion, with 1 being the lowest rating. This rubric was applied to teachers and students of the EMI case study.

The second rubric was designed considering the work of open educational repositories [22], [23], open educational resources [24], evaluation of educational software, and usability of mobile learning objects. Likewise, the rubric had the following 14 criterion: functionality and navigability, control and freedom, visibility of a platform state,

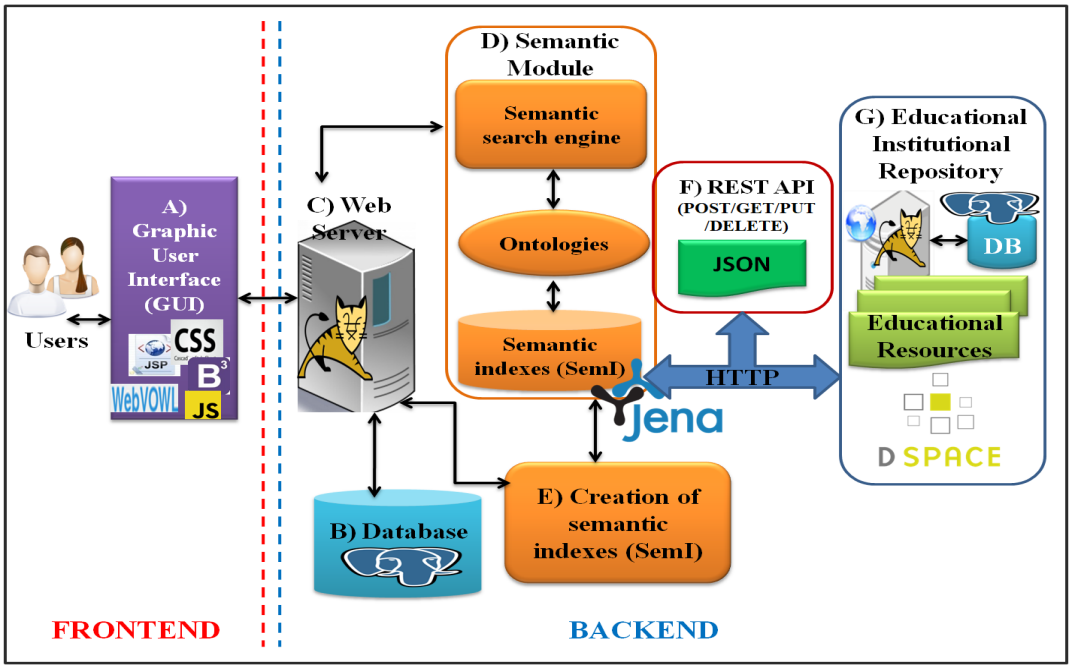

FIGURE 1. MIIDAS Platform architecture and technologies used.

licenses and permits, exploring the field of knowledge*, search for resources, meaningful learning*, satisfaction, audience, content, management of different educational resource format*, characterization of resources according to educational metadata*, institutional guidelines* and educational resource editor*. The criteria with * were proposed in this research. Additionally, the Likert scale was added to the rubric, which had 4 possible responses: 4-largely, 3-moderately, 2-little and 1-not at all. This rubric was applied to the teachers and students of the case study of the UAM-I.

F. MAINTENANCE AND EVOLUTION

According to the results obtained in the evaluation phase, of the comments obtained from the teachers and students of both institutions are focused on the structure, format, functionality, and content of the platform, which allows proposing improvements that will help improve the user experience and give new functionalities to the platform to enrich it.

IV. DESCRIPTION OF THE MIIDAS PLATFORM

Because the platform implements the web architecture, it can be viewed on any desktop, laptop, tablet, or smartphone as long as Internet access is available.

The MIIDAS Platform has a set of tasks according to the teacher and student profile that allows interaction with the platform. In Figure 2, the structure of the platform is presented where the set of tasks it handles are observed, as well as, the role of users.

In order to access the MIIDAS Platform, it is necessary to register which is free of cost. Once registered on the platform, it will request the email and password with which you have register.

After the user is authenticated, the platform shows the set of tasks available for each user profile (teacher and student). In addition, a brief explanation about the purpose of the MIIDAS Platform is displayed at the ''login''. Figure 3 shows the platform login screen, and the set of options that are available to the teacher profile.

However, the ''guidelines'' menu contains rules for the use of the platform and the educational resources contained in it for the teacher and student profiles. Additionally, for the teacher profile a series of guidelines are shown that have pedagogical elements that indicate what should be included in each educational resource of type: exercise, practice, and thematic presentation; as well as examples that indicate the elements in question.

Templates based on pedagogical guidelines are made available in the ''OER creation'' menu, which helps to generate educational resources in pdf format. It should be noted that the teacher can generate resources in this menu. However, the resources are not yet shared, therefore the teacher is the full owner of the resources generated by the platform and only he will decide which resources and under what type of license to share them with the community.

To share a resource it is necessary to access the ''OER upload'' menu, this option shows a form where it is necessary to complete 4 different sections: (i) general data, (ii) content, (iii) educational, and (iv) author of the resource.

Once the form is filled out, the teacher saves the resource, it will be saved in the institutional repository where in parallel a semantic index will be generated in RDF (Resource Description Framework) format, which is composed of 3 layers (bibliographic metadata, content, and links), stored in an RDF store (triplestore).

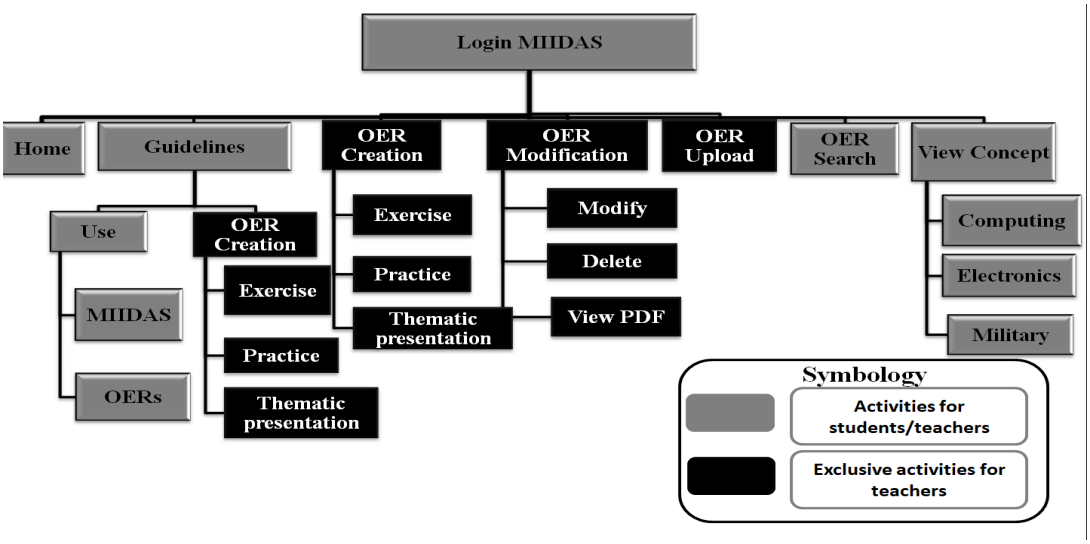

FIGURE 2. Diagram showing the set of tasks of the MIIDAS platform.

FIGURE 3. Access screen and menus of the MIIDAS platform interfaces.

Figure 4 shows an example of a partial semantic index of an educational resource in RDF format and serialized in Turtle [25].

The ''OER search'' menu allows to retrieve and/or consult open educational resources with the help of semantic indexes, as well as, the educational resource ontologies, user profile and domain, which allows obtaining more precise results according to the search filters used (domain, type of resource, language, author, learning style and year of publication). Finally, in the ''view concept'' menu, you can choose the field of knowledge (Computing, Electronics and Military) from which you want to view the set of concepts, definitions, synonyms and relationships with other concepts. Figure 5 shows the screens for (i) OER search and (ii) view concept, this is through a graph built from domain ontologies.

V. RESULTS

In the first case, for validating MIIDAS Platform, the EMI was considered where the first rubric proposal was applied. As mentioned in Section II, 25 teachers were trained and coordinated with the subjects of Programming and Distributed Systems of 2nd and 4th year of the Computer and Informatics Engineers degree, where a total of 39 students interacted.

The general results of the validation of the MIIDAS Platform according to the proposed criteria are presented in Figure 6, where the responses of EMI teachers and students are concentrated.

In Figure 6, it can be seen that the accumulated value of the best validated criteria was: error prevention, interactive, graphic elements, assigned roles, satisfaction, navigability,

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@ prefix ore: <http://pcyti.izt.uam.mx/pmiidas/ontored#>.
@ prefix pu: < http://pcyti.izt.uam.mx/pmiidas/ontousuario#>.
@ prefix co: < http://pcyti.izt.uam.mx/pmiidas/computacion#>.
PREFIX rdfs: <http://www.w3.org/2000/01/rdf-schema#>.
@prefix  rdf: <http://www.w3.org/1999/02/22-rdf-syntaxis-ns#>.
http://148.206.49.134:8081/PMIIDAS/xmlui/bitstream/handle/123456789/37/EstructuraR.pdf?sequence=-1&isAllowed=y
ore:hasTitle "Repetitive Structure For"^^xsd:string.
pu:hasAutor  "Laura Monarca Ortiz".
ore:hasDomain  rdf:type cu: Computing.
ore: hasSubDomain "Programming" ^^xsd:string.
ore:hasTypeER "Exercise" ^^xsd:string.
ore:hasLanguage  "Spanish"^^xsd:string.
ore:hasLearnigStyle  "Pragmatist"^^xsd:string.
ore:hasLicence "Creative Commons (BY CC–ND-2.5-MX)"^^xsd:string.
ore:hasComplexity  "Basic"^^xsd:string.
ore:hasKeywords  "loop, for, exercises"^^xsd:string.
ore: hasDrivingModel "Laboratory"^^xsd:string.
ore:hasTeachingStr  "Problem Based-Learning"^^xsd:string.
ore: hasExternalLink  "https://www.programarya.com/Cursos/C++/Ciclos/Ciclo-for"^^xsd: uri
pu: Laura Monarca Ortiz  rdf:type  pu: teacher.
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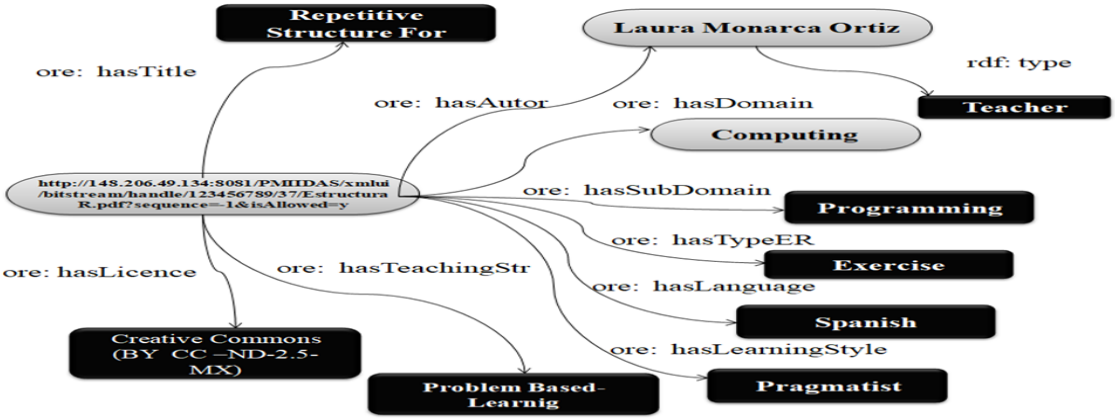

FIGURE 4. Example of a semantic index and its partial representation in format turtle.

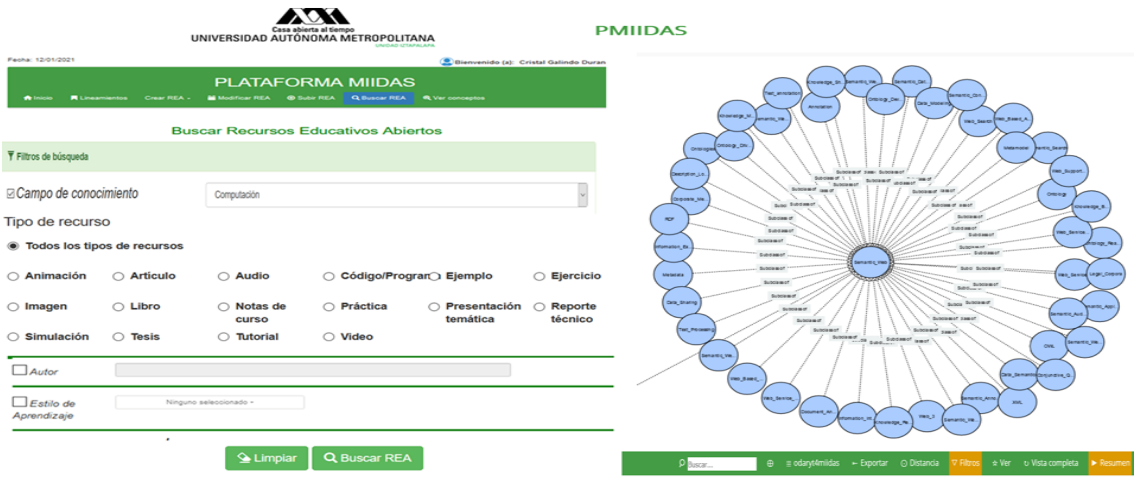

FIGURE 5. Search screens for educational resources and view concepts of MIIDAS platform interfaces.

control and freedom. On the other hand, the criteria with the least favorable opinions were: visual appeal, learning motivation, and activity logic. Also, it is possible to differentiate that the perception of the MIIDAS Platform is more favorable for students than for the teachers.

It is important to mention that the teachers shared a total of 203 resources under the Creative Commons license (CC BY-NC-ND 2.5 MX) in various subjects. Table 2 shows the distribution of shared educational resources by subject.

In addition, the teachers in these tests generated 23 educational resources with the help of the MIIDAS Platform and the resources they had practical, exercises, tutorials, and thematic presentations.

Moreover, it is important to mention that both the students and teachers who performed in the validation of the platform gave different opinions which consisted mainly of improving the search filters of educational resources and adding a greater number of concepts in the domain ontologies, specifically in the military ontology.

TABLE 2. Distribution of shared educational resources by subject.

Subject	Number of shared resources
Programming	32
Basic Mathematics for Engineering	22
Multimedia Systems	18
Expert systems	17
Systems Simulation	15
Distributed systems	15
Advanced algebra	15
Algorithms	14
Database	10
Digital electronic	9
Software development	8
Micro controllers	8
Computer Architecture	6
Networks Computer	6
Semantic Web	6
Analogical Electronics	2
Total	203

The second case study was UAM-I, where the second proposed rubric was applied. The platform was used in the Computer Systems Analysis and Design course, where 30 educational resources were uploaded that contained: practices, exercises, thematic presentations, tasks and scientific and/or dissemination articles, in order to encourage the use of the platform by 35 students that made up the course, who were using the platform for a month, to later evaluate it with the proposed rubric.

On the other hand, 9 teachers were invited to validate the platform, without prior training. They were interacting with the MIIDAS Platform for a month and at the end they were asked to validate the platform with the second proposed rubric. The general results of the validation carried out by the teachers and students of the UAM-I are shown in Figure 7.

In Figure 7, it can be seen that the criterion best evaluated by the teachers was the management of various formats of educational resources with 88.9% and for the students it was the institutional guidelines to generate educational resources with 95.6%.

The precision the criterion with the least positive opinions by the teachers was the exploration of the field of knowledge with 69.4% and for the students it was control and freedom with 72.5%.

Based on the validation of results obtained by the teachers and students of the UAM-I, the MIIDAS Platform was rated favorable, since the average of all the criteria was 81.37%.

The comments and recommendations were received from the teachers, which can be classified into structure/format, functionality, and content. The structure /format comments refer to the organization of the elements of the platform, in addition to the presentation characteristics (font size, colors, among others). The comments of functionality describe improvements or integration of new tasks. The comments of content expose a change or incorporation in the information presented on the platform to clarify it and enrich the user experience. Table 3 shows the different opinions made.

TABLE 3. Comments and recommendations to the Platform MIIDAS by UAM-I teachers.

Type	Comments
Format and structure	To change the fonts and background color in the footer. To put a larger font on the target of the platform. To sort out the subjects of the combos by name and not by code. To separate the welcome message with spaces, because in long names it is above with the icon.
Functionality	To allow editing of resources with a more advanced editor. To improve the presentation of results in the search for resources by providing details of each of them. To associate resources with the concepts shown in the ontology. To generate other educational resources to have a greater variety. To add a menu of standard evaluations. To generate editable resources for students to respond directly.
Content	To rename the Upload OER menu to Share OER. To add more educational resources to have a large number of resources. To add a slogan of the platform. To add pop-up messages explaining the functionality. To incorporate more general words into the visualization of concepts (ontology).

Once the results of the two educational institutions were obtained, a contrast of the common validated criteria between the proposed rubrics was carried out were: (i) Functionality and navigability, (ii) Control and freedom, (iii) Meaningful learning/learning facilitator, (iv) Satisfaction and recommendation.

Comparing with common criteria for UAM-I and EMI teachers, the best evaluated criterion for EMI teachers was control and freedom, as well as the satisfaction and recommendation with 94.4%, respectively and for the teachers of the UAM-I it was the functionality and navigability with 83.3%.

The criterion with the least positive opinions for the EMI teachers was significant learning/learning facilitator with 91.2%, while for the UAM-I teachers it was satisfaction and recommendation with 75%.

Comparing the common criteria by the students of the UAM-I and EMI, the criterion best evaluated by the students of the UAM-I was the significant learning/ learning facilitator with 87.5% and for the students EMI's was functionality and navigability; also, satisfaction, and recommendation with 96.9% for each of the criteria.

In summary, the MIIDAS Platform was validated by a total of 108 teachers and students in both institutions, of which 9 teachers and 35 students were from UAM-I and 25 teachers and 39 students were from EMI.

VI. DISCUSSION

As mentioned in Section II, there are various works that propose strategies or frameworks to integrate semantic technologies to repositories, such as [7], [8]; our approach is different, as it is comprised of the methodology, platform, and ontologies, as well as, the set of instruments

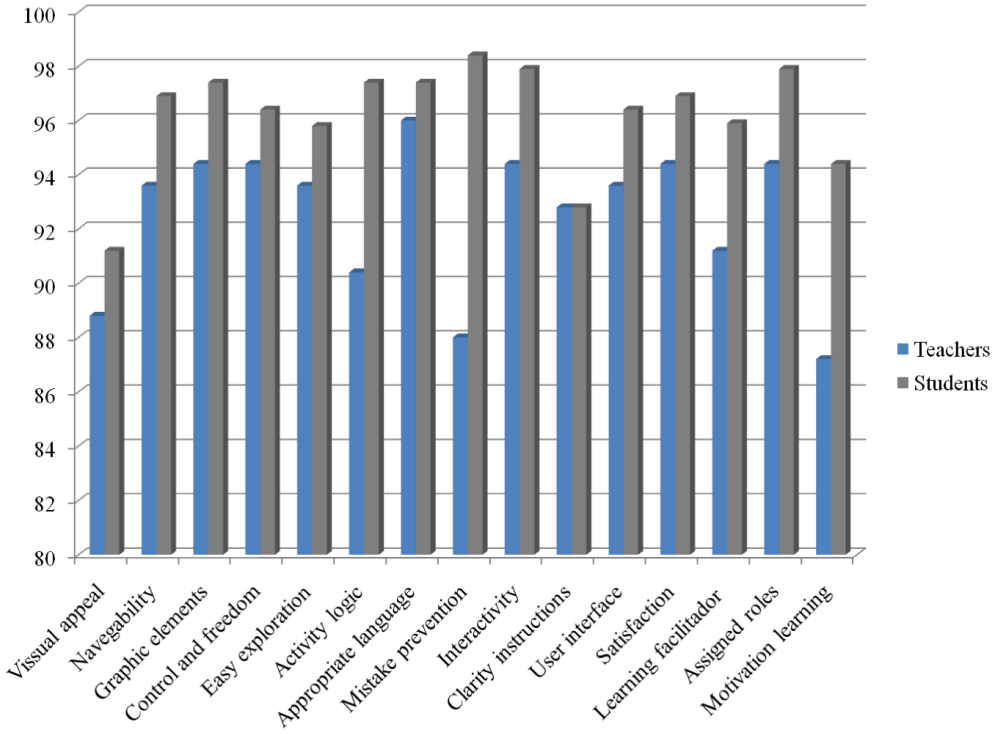

FIGURE 6. General results of the validation of the MIIDAS Platform of EMI teachers and students.

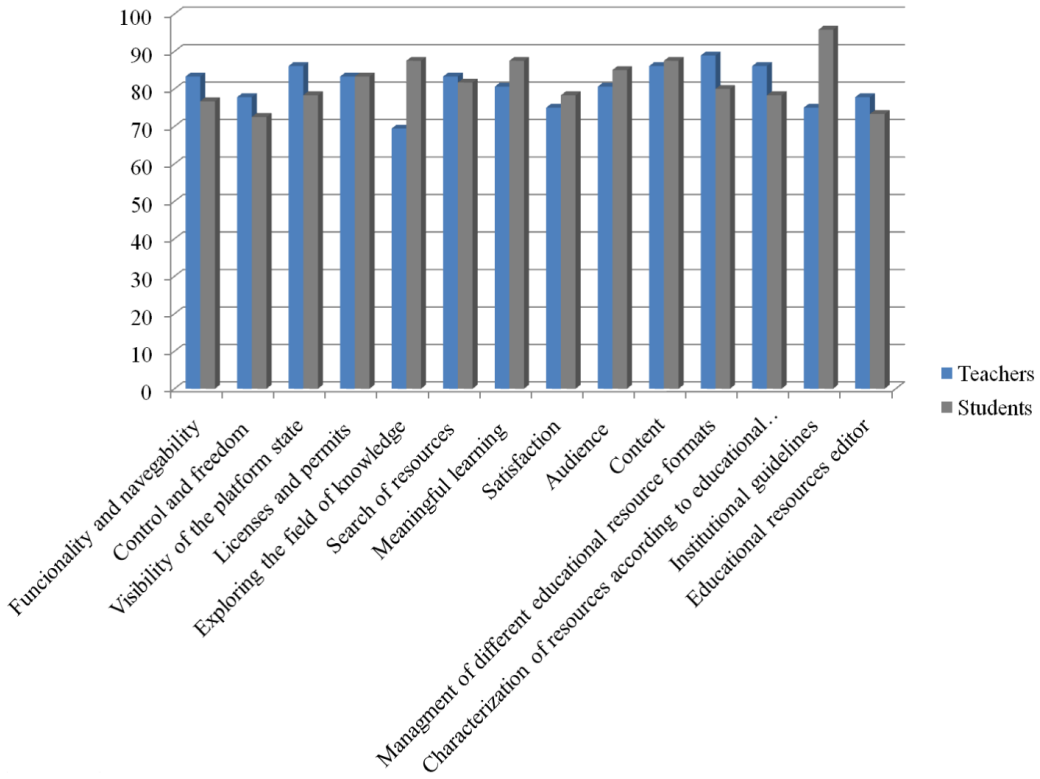

FIGURE 7. General results of validation of the MIIDAS Platform of the teachers and students of the UAM-I.

developed (guidelines, questionnaires, and evaluation instruments).

The MIIDAS Platform differs from works [10]–[14] since it was developed based on the needs of teachers and students of educational institutions (EMI and UAM-I), allowing the design and construction of an ad hoc platform to the requirements of the members of the institutions, until the evaluation of the platform, to allow its evaluation and maintenance.

On the other hand, the platform allows establishing pedagogical guidelines to create educational resources of the type: exercise, practice, and thematic presentations. It provides forms to generate these resources. It also empowers to describe each resource through semantic indexes (linked open data) that consider the metadata of the OAI-PMH protocol and other metadata of an educational nature such as: learning style, driving model and associated teaching strategy, which they not only help improve resource retrieval, but allows teachers to find resources for a population with the same learning style or for a particular teaching strategy.

Additionally, the MIIDAS Platform is similar in visualization to the work presented in [13]. However, it differs in the presentation of the concepts through the ontologies, offering the possibility of going through them graphically, forming a graph of knowledge in the areas of Computing, Electronics and Military, in addition to considering any type of resource and not just focusing on thesis or dissertation papers.

VII. CONCLUSION AND FUTURE WORK

This article presents the design and construction of the MIIDAS Platform, which integrates technologies from the Semantic Web for the search and retrieval of open educational resources and concepts related to the domains of Computing, Electronics and the Military Field. At the university level, as well as, the proposal of guidelines for the creation of educational resources of the type: practice, exercise and thematic presentations. In addition to presenting the results of the validation of the platform through the development of two instruments (rubrics) that take different work criteria such as: educational software, usability of mobile learning objects, repositories, and open educational resources.

The MIIDAS Platform puts a semantic layer on each educational resource through the RDF format, which with the help of the Digital and Educational Resource ontologies allow the retrieval of educational resources according to the user's preferences and together with the domain ontologies allows the user (teacher and student) learn more about a particular topic. Also, ontologies allow the development of more intelligent applications since they allow inferring implicit information in them.

The platform can be seen as an institutional repository that integrates information resources from different knowledge domains, as well as diverse formats, learning styles and educational modality in different locations. A semantic approach is used to facilitate the flow of Open Educational Resources both within and outside the institution in question, allowing for the open and connected exchange of resources.

The application of rubrics allows validating the platform, allowing to objectively identifying improvements. In addition it offers the possibility of making it more user-friendly and improving the user experience. The proposed rubrics can be used to validate other developed semantic platforms and establish points of comparison.

The construction of educational platforms is important for educational e-innovation. However, it is necessary that the institution through its directors establish policies to encourage and recognize teachers in their work of creating educational resources; as well as sharing their knowledge through resources. Likewise, teachers are a key element in motivating the use of the platform and the resources found in it by students.

The MIIDAS Platform can help promote learning and the generation of educational resources in a much more active way, since both teachers generate resources and students acquire skills in searching and selecting material according to their specific needs. Likewise, the platform can contribute in face-to-face and distance education.

The document provides the basis for the development of platforms that will help to spread the benefits of open access and the construction of semantically enriched data sets.

With the support of the comments issued by the teachers and students; as well as results obtained from this research, a set of following future works have been identified:

- Expand the scope of the MIIDAS Platform to allow the generation of other educational resources to support teachers.
- Show the resources associated with a topic in the concept visualization.
- Implement a REST service for communication with other repositories or educational platforms to test functionality and integration.
- Increase the concepts in other areas not considered in different domain ontologies.
- Generate new rubrics that allow validating the platform considering other validation criteria and scale.

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