Semantic Management of E-learning in College of Engineering at Kerbala University

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Abstract

Internet is the essential tool of transmitting information and providing services to facilitate the human daily jobs. The internet has a great impact on various fields of life, including learning, where e-learning emerged as one of the services provided by the Internet. E-learning is a distance knowledge acquisition by using electronic methods and it has increased dependence in the two decades ago. One of the problems facing e-learning is contents management because E-learning differs from traditional learning by overcoming the conditions of time and place. The semantic web is the restructuring of the current web to managing data and resources to become more effective for human and machine. The semantic web is based on an ontology which is defined as a descriptive representation of data and resources. It is expected that Semantic Web technologies and Ontologies will affect the next generation of e-learning systems and applications. Resource Description Framework (RDF) is a general modeling for data representation by using a variety of syntax. A friend of a friend (FOAF) and Dublin Core (DC) are a vocabulary description depending on RDFs' rules.

This paper presents a semantic management of E-learning in College of Engineering at University of Kerbala based on ontology of users' profile, scientific activities, and lessons. RDF, FOAF, and DC are used to create a syntax of metadata. The proposed work was evaluated according to average precision and recall of the search's results and social network metrics.

The results demonstrate that FOAF is a good way to represent nodes and relations and this improves using it in searching without access the database. FOAF has the ability to gathering dispersed data into common interests.

Keywords: Semantic web, Ontology, E-learning, Semantic E-learning, E-learning management.

1. Introduction

The Internet is an amazing mesh of information networks which are consist of a huge number of documents and has an important impact on daily life[1]. Decreased educational material costs, reduce time cycle to get information, facility information access and others led to exponential internet usage. E-learning is one of the terms that related with the advantages of the internet and a large number of studies explained it from different views such as pedagogical, technique, philosophical and others. E-learning is a multimedia educational using electronic knowledge tools via the network to provide a learn at any time and everywhere. Knowledge is an information extraction, creative and experiences and this means a knowledge is an integrated community of thinking activities in parallel continuous ways and never stops[2]. The components of E-learning are:

1. Users: User in E-learning is any person interact with a system and includes teacher, student, administrators and others.
2. Courses: Refers to contents, structure, requirements, tools, registered time and others.
3. Management: Management means system organization and it includes a coordinate between system elements, content engagement, design, usability, and others.

Internet today is ill-suited for the learning management because of the information dispersed [3]and limitations in the links between documents. Current web deals with the syntax of keywords not with the meaning of them[4]. For example, when a student search for the word "pointers ", the results will be a pointer (computer programming), a pointer (dog breed), a pointer (presentation) and others. Every one of the results refers to a special scientific field and different with others. An ontology is a meaningful representation systematic for relationships." An ontology is an explicit specification of a conceptualization" [5]and these specifications give an intelligent description for related words. For example, if the learner is studying computer programming and this will determine the leaner's profile, the results will be relevant to the interests' domain. Resource Description Framework (RDF) is a syntax written in Extensible Markup Language (XML) for meaning representation of entity–relationship. RDF has a variety of syntax which cionsists of three triples (subject , predicate and object)[6]. The friend of the friend (FOAF) is an evolutionary description of interlinks words and vocabulary between deferent datasets. Dublin Core (dc) is a standard for vocabulary description and a "modern form of catalog card -- a set of elements (and now qualifiers) that describe resources in a complete package"[7].

College of Engineering at University of Kerbala was established on 2006 and consists of seven departments: Mechanical department, Civil Department, Electrical, and Electronics department, Petroleum department, Biomedical department, Prosthetics and Orthotics department, and Architecture department. It has postgraduate in the Mechanical department and Civil department. Its objective is attaining an international level in engineering sciences and applications. The college contains 119 instructors,169 employees, and 1353 students. This paper aims to propose a management system of E-learning in the College. This system based on ontology of relations between entities (Users, lessons and scientific activities) by using RDF, FOAF and DC.

This article is structured as follows: Section 1 introduces the E-learning. Section 2 shed light on an overview about some related studies. Section 3 describes the proposed system whereas section 4 evaluates the proposed system.

2. Related works

E-learning is set of integrated techniques used for education and training via physical equipment and virtual tools. E-learning is one of the services that provided by internet especially after the exponential growth of data and technology to the internet. The current internet has limitations in E-learning management because of the data interconnections which are cause lack of accuracy in the query results. There are many studies to solve this problem to get the required results. The semantic web integrates technologies to get more intelligent E-learning managements via the description of data and interconnections. W. Westera was tried re-establishing the learning's contextual via new technologies to overcome the restrictions of classical learning (place and time). He discussed four cases of learning: first case: it is the classical learning which depended on direct communication without any technology, the second case used technology to present information

like power point or pictures, third case using technology to simplify information for example animations and fourth case assumed that virtual tools integrating with real worlds such as face-to-face communication technology or virtual box. The end result of the paper is that there must be integrated and between physical tools and virtual[8]. Bologna Declaration which was aimed to create a common qualifications' standards of European Union countries to improve the relationship between knowledge levels and labor markets. R. Vas in [9] discussed Educational Ontology's description depending on Bologna Declaration that improves the outcomes by a broad construct include motivational components to find missing knowledge fields. L. Stojanovic and others in [10] concluded that Semantic Web can be a backbone for e-Learning by using an ontology to describe learning materials and this will make search easier. The main aim of education is improving the student performance. Student performance must be evaluated periodically to improve the educational system. M. Graff in [11] Studied the students' performance in Psychology course in 140 University undergraduates. This paper focused on comparing students' performance in four cases: the first case: students' performance between coursework assignments and online assessments, Second case: students' comprehension between coursework assignments and online community, third case: between online student's marks and their participating in online assessment and fourth case: between students' cognitive and coursework. The paper's result was positively students' performance relation between coursework and online assessments. there is a need to generate and organize Knowledge representation in E-assessment and to improve the outcomes of learning there is a need to monitor the development progress. L. Romero and other in [12]presents an ontology network to support the semi-automatic assessment within pedagogical criteria. To enhance retrieve resources this paper presented the data of relation between domain ontologies. T. Shopova discussed current student in the digital age through offering a new educational practice and learning methods. the recommendation of this paper is that digital technologies can be used to improve the quality of learning [13]. K. Al-jubori and M. Yaseen in [14] proposed a mathematical system according to criteria for grades' adjustments at Amman University.

3. The proposal system

This paper aims to propose an approach for the management system to organize and store the learning resources at the college of engineer/University of Kerbala. This system is a prototype for the semantic e-learning to create meaningful relationships between nodes to facilitate the user's task and learning according to the (user's) interests. The node can be defined as each element in the system and has a relation with other elements. The relation between nodes may be classified into two main types [15]:

1. Direct relationships: It's the direct relationship between two objects. For example, the relationship between teacher and a student in the class
2. Indirect relationships: It's the relationship between two objects through another thing relating to them. For example, the relation between two students in different classes study math

In this system, the relations are mixed between direct and indirect and get a third type called a hybrid relationship which can be defined as multi-relation between nodes as shown in figure (1):

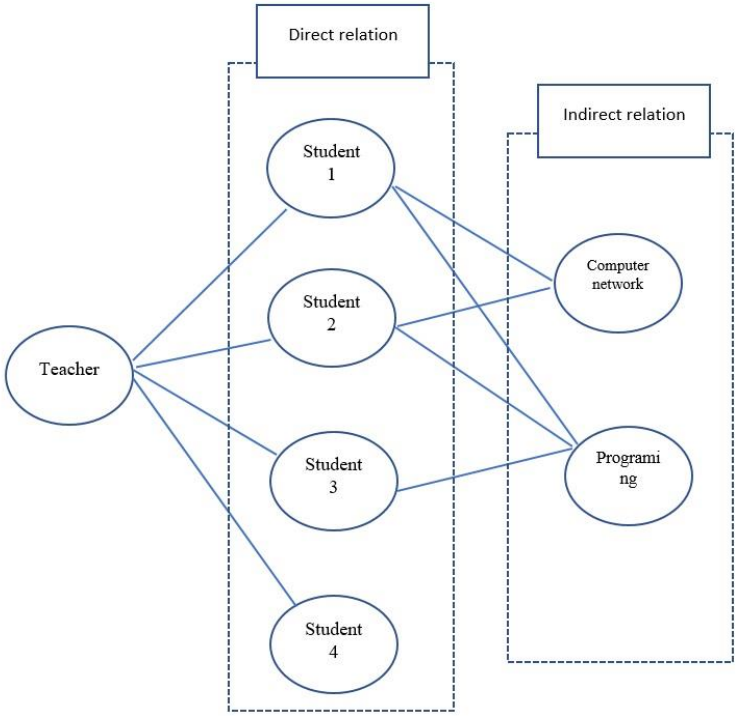

Figure 1: Hybrid relation

3.1 System Nodes

There are three main nodes represent the key elements of E-learning in the system:

3.1.1. User's ontology:

In E-learning a user may be instructor or student and there is an interaction between them according to three relationships between them: Instructor – Instructor, Instructor-student, and Student – student. The personalized information makes the system more reliable and can be interpreting by computer through improving the precision and recall by retrieving the relevant results because of

- This information makes the nodes able to interact with the system and share ideas, activities, posts, and others according to common interests
- The personalized information helps the system to classify user according to his behavior

The personal information in the system is divided into three classifications

- Biographical information: This information consists of two main parts
- ✓ Log information: Its include ID and password. ID also used to identify user especially for privacy instead of his name like announcement marks.ID consists of four parts and every part refers to a specific meaning
- First part: It's consist of four digits and refers to the type of user according as shown in table 1:

Table 1: Types of users

Number	Representation
10	Instructor – Doctor
11	Instructor – Master
12	Instructor – Bs
20	Student – Morning study
21	Student – Night study
22	Postgraduate student

- Second part: It's consist of four digits and refer to year of registration
- Third part: It's consist of one digit and represent user's department as shown in table 2

Table 2 : Departments' numbers

Department	Number
Mechanical	1
Civil	2
Electrical and Electronic	3
Petroleum	4
Biomedical	5
Prosthetics and Orthotics	6
Architecture	7

- Fourth part: It's referee to number of user in department and consists of two digits

✓ General information: It consists of general information like first name, father name, family name, gender, birthday, location of birth and others

- Academic information: It define the specializations. There are three main categories

✓ General specialization: Its consists of the main seven departments Mechanical department, Civil Department, Electrical and Electronics departments, ….

✓ Medium specialization: It's represented the major branches in the departments, for example Electrical and Electronics department consists of Electric and Electronics

✓ Specific specialization: It's represented the subfields of the major branches, for example Electric specialization consists of power, Alternating current direct current, power electronics and others

The purpose of the steps above is to create user's profile ontology. For example

```
<foaf:user rdf:ID="me">
<foaf: ID>
      <type>20</type>
<year>2015</year>
<deparment>3</department>
<number>10</number>
</foaf: ID>
<foaf:first_name>Muhammad </foaf:first_name>
<foaf:second_name>Aqeel </foaf:second_name>
<foaf:surname> </foaf:surname>
<foaf: gender>male</foaf: gender >
<foaf: address> Kerbala</foaf: address >
<foaf: birthday>21/1/2005</foaf: birthday >
<foaf: specialization>
    <general_specialization>Electrical & Electronic</general_specialization>
    <medium_specialization>Electrical</medium_specialization>
    <specific_specialization>Power</specific_specialization>
</foaf: specialization>
</foaf:user>
</rdf:RDF>
```

3.1.2 Scientific activities

It includes the important information about research interests and the scientific activities' description. The activities may be conference, journal, book, teamwork, and others.

In order to used exemplary description, Dublin Core (DC) was used for describing scientific activities for example

```
<?xml version="1.0" encoding="UTF-8"?>
<metadata
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xmlns:dc="http://purl.org/dc/elements/1.1/">
<dc:title>C++: A Beginner's Guide</dc:title>
<dc:creator>Herbert Schildt</dc:creator>
<dc:subject>C++</dc:subject>
<dc:description>Work with all C++ compilers, including visual C++</dc:description>
<dc:publisher>brandon A.Nordin</dc:publisher>
<dc:date>2004</dc:date>
<dc:type>Text</dc:type>
<dc:format>PDF</dc:format>
<dc:language>English</dc:language>
<dc:relation>Reference book</dc:relation>
<dc:coverage>Programming in C++</dc:coverage>
<dc:rights>Copyright material</dc:rights>
</metadata>
```

3.1.3 Learning's requirements

E-learning provides a huge data without conditions of classical education (time and place) which ensure the type and quantity of data. Properties describe characteristics of classes and give meaning for retrieving information especially when there is the number of similar classes and different syllabus. Information should be providing what the user needs which consists of two parts:

A. Administrative requirements :It's consist of the basic administrative requirements for lessons like units, required courses or elective course, specialization of the subject and others

B. Scientific information: It's consist of the basic information like subject's code, objective of the subject, references, keywords, syllabus and others.

3.2 The Relations Building

It's clear that grouping users according to their interests is very important for reinforcement cognitive process. To achieve this, there are three steps:

- The Machine has capable of reading the meaning of syntax.
- Internal links between nodes. The purposes of these relations are to create friendships or groups between users according to their common things

- External links to extract information from external resources by using the software package RDF API for PHP V0.9.6 (RAP)

When the user first time login , he must create account as shown in figure (2 a) and (2 b)

Figure 2 a: Log in page

Figure 2 b :A new account

3.2.1 Friendships

Known property in FOAF defines a friendship between two entities for example:

<foaf:user rdf:ID="me">

<foaf: ID>

<type>20</type>

<year>2015</year>

<deparment>3</department>

<number>10</number>

</foaf: ID>

<foaf:first_name>Muhammad </foaf:first_name>

<foaf:second_name>Aqeel </foaf:second_name>

.

.

.

<foaf: knows>

<foaf: user>

<foaf: ID>

<type>20</type>

<year>2015</year>

<deparment>3</department>

<number>24</number>

</foaf: ID>

<foaf:first_name>Hussien </foaf:first_name>

<foaf:second_name>Jaafar </foaf:second_name>

</foaf: user>

</foaf: knows>

</foaf:user>

The representation of connection between users will facilitate for them to discover friends based on common interests or friend of friend, for example, if we assumed that Ali wants to add Muhamad as friend

1. Ali search about Muhamad named or write his interest's topic and select common relation (interest or friend of friend or specialist)
2. Ali will click on the button "Add friend " in Muhamad's page
3. Friendship will be creating between Ali and Muhamad and a notification will send to Muhamad's email tell him that "Ali added him as friend"
4. If Muhamad wants to remove Ali, he can click on the button "Remove ".

3.2.2 Scientific group

The Scientific group is a collection of people interacting with each other in a common purpose and this is an essential in learning. Every course in this system has a group with two types of authorizations:

1. Instructor's authorization can add new topic and reply students' comments as shown in figure (3 a)

2. Student's authorization can only comment as shown in figure (3 b)

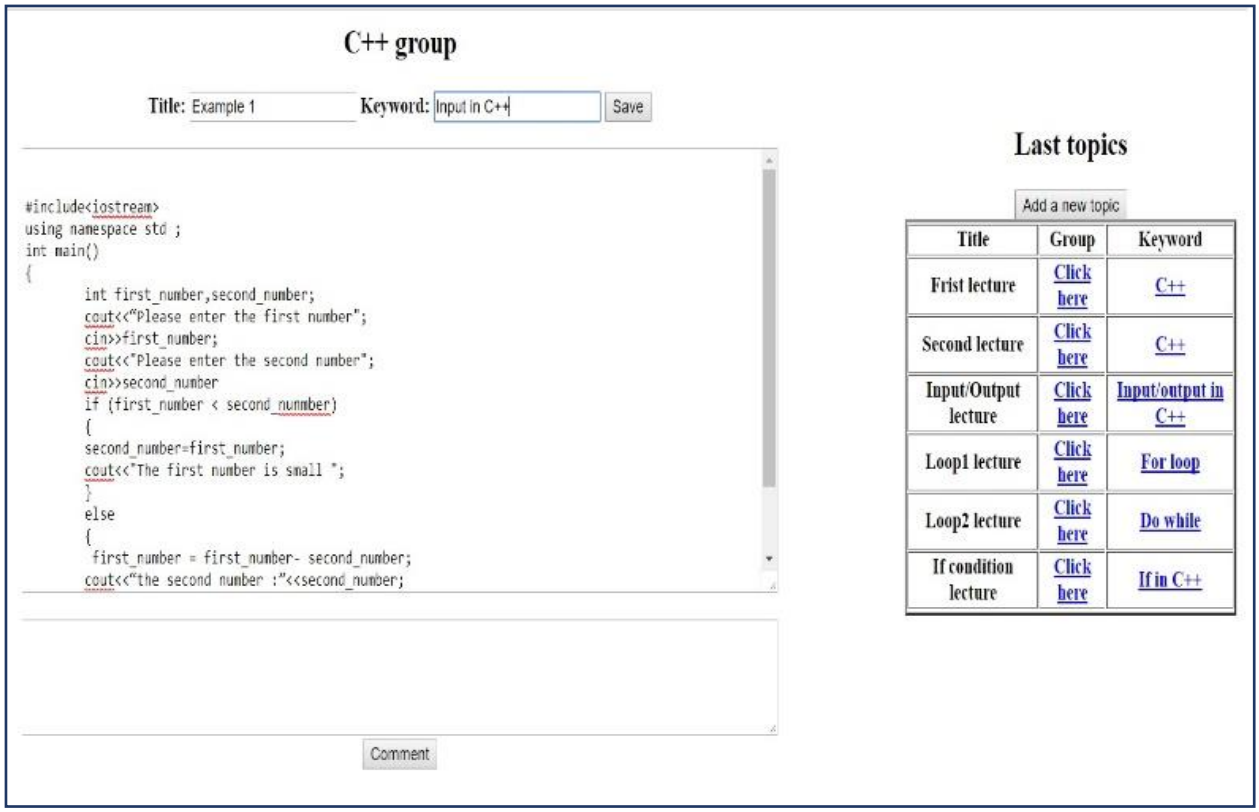

Figure 3 a: Instructor's group

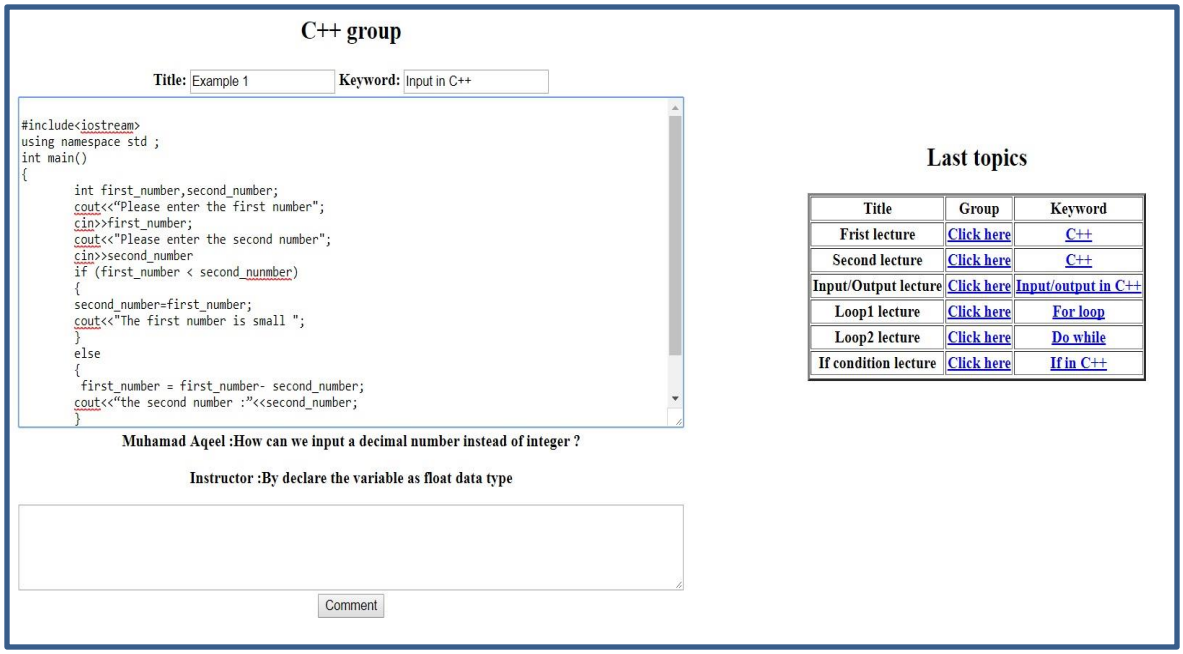

Figure 3: b Student's group

4. The experimental results

The domain of the proposal system is restricted to Universty of Kerbala / College of Engineering.The experiment is executed on 30 instructor ,100 students, and 155 lessons distributed between the Mechanical Department, Civil Department , Electrical, and Electronics department, Petroleum department and Architecture department. PHP is used to create the interface between user and ontology.

The personal page contains as shown in figure (4)

1. Search bar with options of search
2. Lessons table contains the lessons that user interest
3. Friends' table consists of name of friend, their homepage and option " remove" if the user wants to remove a friend
4. Mail form to receive email from other users

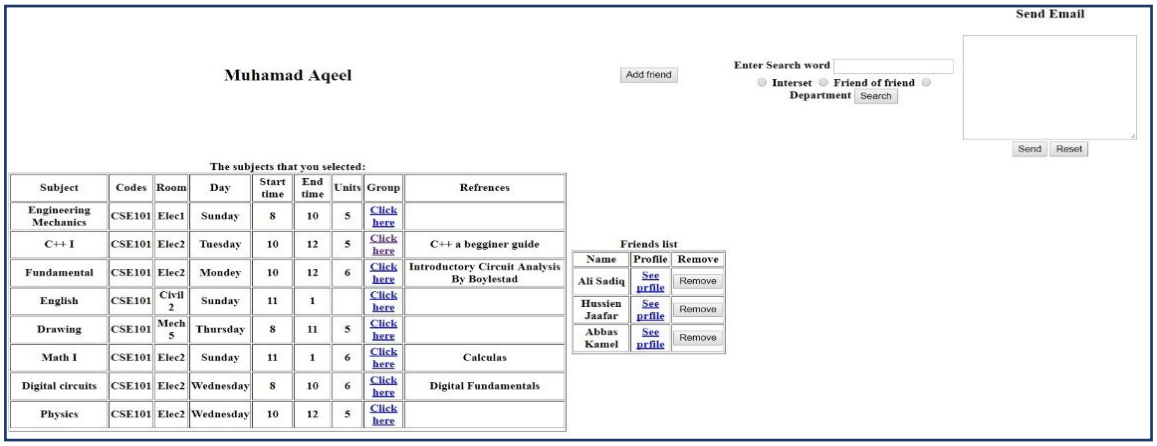

Figure 4: Personal page

The average recall and precision of the work are 91.4% and 89.23% respectively for 10 executed queries as shown in the Table (3)

Table 3 Precision and recall

Object	Word Search	Option selected	Relevant & Retrieve	Relevant	Retrieve	Recall	Precision
Circuit network	Circuit	None	95	107	110	0.887	0.863
Ali	Ali	Interest	30	30	30	1	1
Sanaar	Sanaar	Friend of friend	2	2	2	1	1
Loop in programing	Loop	Department	60	66	70	0.909	0.857
Mesh computer network topology	Mesh in network	Interest	15	18	20	0.833	0.75
Karnaup-map	K-map	Interest	55	55	55	1	1
Diode in physic	Diode	Interest	8	9	8	0.888	1
Diode in physic	Diode	Friend of friend	12	15	15	0.8	0.8
Power in electric	Power	Department	43	47	50	0.914	0.86
Power in electric	Power	Friend of friend	50	55	63	0.909	0.793

The nodes and relations are mapped by using Gephi-0.9.1 as shown in figure (5)

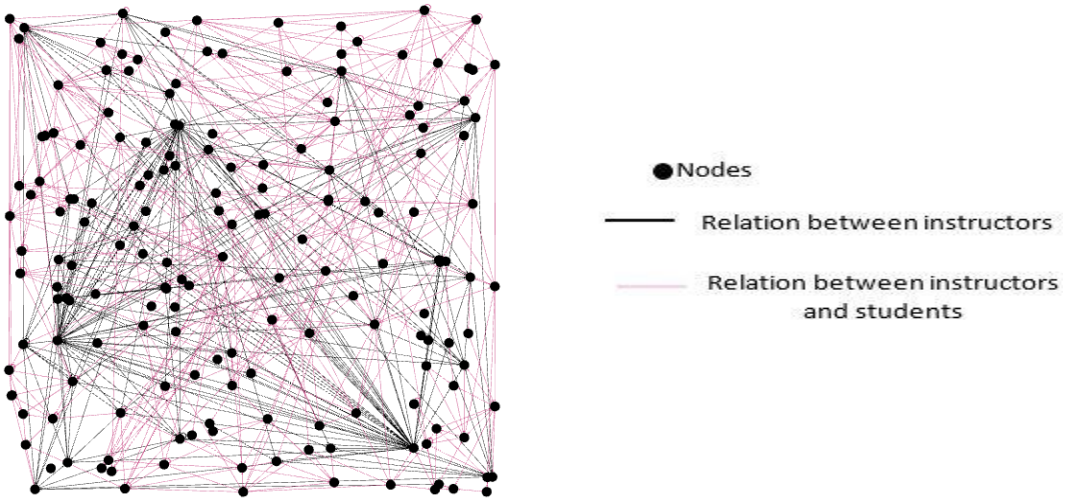

Figure 5: The system's social Map

The Sociocentric Analysis shown in table (4)

Table 4 social network metrics

	Metrics	Value
1	Average degree	7.609
2	Average Weighted Degree	3.802
3	Average Path length	4.355
4	Density	0.022
5	Number of Weakly Connected Components	19
6	Number of Stronlgy Connected Components	42
7	Average Clustering Coefficient	0.185

5. Conclusions and Recommendations for future work

This paper proposed Semantic management of E-learning in College of Engineering at Kerbala University which is built on E-learning and applied in College of Engineering. The system is done by depending on personalized components of E-learning (users, courses, and scientific activities). The system was evaluated by performance metrics (precision and recall) and social network metrics. This work end results with FOAF is a good way to represent nodes and relations and this improves using it in searching without access the database. FOAF has the ability to gathering dispersed data into common interests. The detailed description gives a power to the system, for example, if there are 10 students in the Mechanical department and 15 students in Electrical and Electronics department want to register in a math course. Instead of two courses, one course will open depending on the syllabus details and this will provide classes and instructors.

The future work will be an attempt to enable the system to automatically generate the relations and intelligently management.

CONFLICT OF INTERESTS.

- There are no conflicts of interest.

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الادارة الدلالية للتعليم الالكتروني في كلية الهندسة بجامعة كربلاء

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الخلاصة

الإنترنت هو الأداة الأساسية لنقل المعلومات وتوفير الخدمات. الإنترنت له تأثير كبير على مختلف مجالات الحياة، بما في ذلك التعلم، حيث ظهر التعلم الإلكتروني باعتبارها واحدة من الخدمات التي تقدمها شبكة الإنترنت. التعلم الإلكتروني هو اكتساب المعرفة عن بعد باستخدام الطرق الإلكترونية، وزيادة الاعتماد عليها في العقدين الماضيين. واحدة من المشاكل التي تواجه التعلم الإلكتروني هو إدارة محتويات لأنه يختلف عن التعلم التقليدي من خلال التغلب على ظروف الزمان والمكان. الشبكة الدلالية هي إعادة هيكلة الشبكة الحالية لإدارة البيانات والموارد لتصبح أكثر فعالية للإنسان والآلة. وتستند الشبكة الدلالية على علم الأنماط الذي يعرف بأنه تمثيل وصفي للبيانات والموارد. ومن المتوقع أن تؤثر تكنولوجيات الويب الدلالي والانطولوجيا على الجيل التالي من نظم وتطبيقات التعلم الإلكتروني. إطار وصف الموارد (RDF) هو نموذج عام لتمثيل البيانات باستخدام صيغ مختلفة. من الصيغ المستخدمة لتمثل المفردات هي FOAF وDC والي تعتمد على قواعد RDF.

يهدف هذا البحث إلى تقديم مقترح إدارة دلالية للتعليم الالكتروني في كلية الهندسة بجامعة كربلاء والتي تعتمد على علم الانطولوجيا للملفات الشخصية للمستخدمين والأنشطة العلمية والدروس. تم استخدام RDF وFOAF وDC لإنشاء جمل البيانات الوصفية. تم تقييم العمل المقترح بواسطة قييم الإرجاع والدقة لنتائج البحث ومقاييس الشبكة الاجتماعية.

وتظهر النتائج أن(FOAF) هو وسيلة جيدة لتمثيل العقد والعلاقات وهذا يحسن استخدامه في البحث دون الوصول إلى قاعدة البيانات. (FOAF) لديه القدرة على جمع البيانات المشتتة الأكثر فائدة.

الكلمات الدالة: الويب الدلالي، الانطولوجيا، التعليم الالكتروني، التعليم الالكتروني الدلالي، ادارة التعليم الالكتروني.