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# DEVELOPMENT OF A VISUAL SEMANTIC WEB ONTOLOGY BASED LEARNING MANAGEMENT SYSTEM

Uzoma, Peter Ozioma., Amanze, Bethran Chibuike., Agbakwuru, Alphonsus Onyekachi and Agbasonu V.C.
Department of Computer Science, Faculty of Physical Sciences,
Imo State University, Owerri, Nigeria

***Abstract:*** **This paper specifically aim at developing a visual semantic web ontology based e-Learning management system. The existing e-learning platforms have failed to address some challenges including managing the huge e-Learning content that is continuously grows on the web, meeting the learner's requirements when searching for an electronic learning content, representing the knowledge in a format that is easy to read and making it capable of thinking and thus allowing the re-use of e-Learning objects. In addition, most search results contain some irrelevant documents that cannot serve the need of the learner. Therefore, this thesis designed a common interface for learners, instructors, and administrators of academic institutions to upload and access learning materials. The new system created an ontology repository to maintain learners' personalization details and taxonomy of the learning resources and integrate the knowledge embedded in many remote ontologies for improved e -Learning management system. In addition, an intelligent search engine through which learners can semantically search their learning materials and filter the search results returned by the search engine based on some semantics and the user's preferences created. These designs simulated using a web-system developed with PHP, MySQL and JavaScript. The System Design followed the Object Oriented Design and Analysis Methodology for componentization of the system modules giving room for coupling, decoupling, modification, encapsulation and reuse, as well as easy maintainability. Unified Modeling Language extensively used to simplify the explanation of the system modules. The software performance wastested; the result shows that visual semantic web ontology-based e-Learning management system achieved 95% accuracy in returning the desired web search result.**

***Keywords:*** **Instructors, Administrators, Ontology, and Productive rule.**

## I. INTRODUCTION

All over the world, learning is a critical support mechanism to enhance the knowledge and skills of learners and at the same time, it is useful for educational institutions. The traditional way of learning where students and teachers have to meet at a designated location (classroom) for learning to take place now viewed as not being efficient. With the introduction of information technology into the education system, learning process been modified to meet up with the present day need in educational sector. E-Learning is associated with any learning process that incorporated any form of technology. E-Learning can be defined as all that activity utilizing information transfer and knowledge utilization during the learning process with particular attention to computer-based technology involving learning activities (Khan, 2015). E-learning framework can be analyzed as an ingenious method for learner-centric, collaborative, conveying, and simplified learning environment to wherever, whenever and whomever by exploiting the elements and assets of diverse digital advances alongside different kinds of learning resources suitable for an open, disseminated and adaptable learning situation (Graf& List, 2015).

E-learning can be achieved in different forms such as online learning, virtual learning environment, computer based training and computerized collaborations. Delivery of learning materials for e-learning can be synchronous or asynchronous depending on the facilitator. A learner, using the web as a means of knowledge acquisition needs access to learning materials; strategies for learning; time to learn; advices on what to learn; feedback on progress; involvement and interactivity as instructional helps and supports (Adebayo & Oyewale, 2015). Interactive learning environments are instructional methods aimed at strengthening the learner's knowledge, through the interactive effort, providing an environment that fuels and enriches the process that allows learners to interact to solve a problem. Interactive learning environment tends to change the traditional way of learning by introducing different mechanism for learners, mainly for interaction and sharing ideas. Interactive learning, involving social networking and

urban computing, started to be important by the policies defined by the governments of the most developed countries (Vainion paa, 2016). E- Learning has two general approaches: self-paced and facilitated/instructor-led approach. Self-paced learners are alone and completely independent, while facilitated and instructor-led e-learning courses provide different levels of support from tutors and instructors and collaboration among learners. E-learning courses combine both approaches more often, but for simplicity, it is easy to consider the two separately. The World Wide Web (WWW) has come along with many technological tools to make the learning process to be more efficient. The introduction of e - learning into the educational system is to replace old-fashioned learning process with efficient and on-demand process of learning, relevant to the user desires. E-Learning has its origins in computer-based training (CBT), which was an attempt to automate education, replace a paid instructor, and develop self-paced learning (Ljiljana et al.,2018). The current WWW is a powerful tool for research and education, but its utility hindered by the failure of the user to navigate easily the reputable sources for the information he requires. Most often learners spend hours searching for particular information needed on the WWW and this makes the e learning management system to be tedious. Current E-learning systems focused not only on courses content delivery but also on personalized and adaptive learning style of learners. Some challenges are facing the existing e-Learning systems, including managing the huge e-Learning content that is continuously grows on the web, meeting the learner's requirements when searching for an electronic learning content, representing the knowledge in a format that is easy to read and makes it capable of thinking and thus allowing the re-use of e-Learning objects. Most search results contain some irrelevant documents that cannot serve the need of the learner. There is need to reduce the search results to streamline it to the information being sought for by the learner and in order to solve this problem, this research focuses on developing a visual semantic web ontology based e learning management system.

Semantic web is a new WWW architecture that will support Web content and associated formal semantics (Berners-Lee, 2018). Semantic web is an evolving extension of the WWW in which web contents can be expressed in natural language and in the form that can be understood, interpreted and can be used, thereby permitting learners to find, share and integrate information more easily.

The basic layers of semantic web are; the Extensive Markup Language (XML) layer, which represents the structure of data; the Resource Distribution Framework (RDF) layer, which represents the meaning of data; the Web-Ontology Language **(**OWL) layer, which represents the formal common agreement about meaning of data; and the Logic layer, which enables intelligent reasoning with meaningful data (Ljiljana et al.,2018). The term ontology has been widely used in recent years in the field of Artificial Intelligence, computer and information science especially in domains such as, intelligent information integration, information retrieval and extraction, knowledge representation, and database management systems (Guarino, 2016). Ontology's in the context of the semantic web are specifications of the conceptualization and corresponding vocabulary used to describe a domain. Any semantic on the web based on an explicitly specified ontology, so two different semantic web applications can communicate by exchanging their ontology's (Smrz, 2014). Ontology for the e-Learning processes can be set up in various ways, but ontology will include a dictionary with explanation of the terms, and indications how the terms related to another. This approach will give a valid tool for the learning process. The aim of this study is to develop a visual semantic web ontology based e- learning management system. Learning management system (LMS) is a software application or Web-based technology used to plan, implement, and assess a specific learning process. A learning management system provides the lecturer with a way to create and deliver content, monitor student participation, and assess student performance. A learning management system may also provide students with the ability to use interactive features such as threaded discussions, video conferencing, and discussion forums with comprehensive distribution from lecturers to students (Ghoniem et al., 2010).Therefore, this research will focus on building an e learning management system that will integrate advanced technological tools like semantic web ontology for delivering an efficient e-learning system that will overcome the challenges facing the existing e-learning platforms. The existing e-learning system based on web, which can used remotely every time and everywhere. But these learning platforms have failed to address the challenges including managing the huge e-Learning content that is continuously grows on the web, meeting the learner's requirements when searching for an electronic learning content, representing the knowledge in a format that is easy to read and makes it capable of thinking and thus allowing the re-use of e-Learning objects. Most search results contain some irrelevant documents that cannot serve the need of the learner. Therefore, the existing e-learning management system has the following challenges:

(1) Absence of data integration.
(2) The existing system does not properly handle semantics and personalization
(3) Inability to provide intelligent access and management of Web information
(4) Lack of connectivity for related resources on a particular domain.
(5) Low degree of self-directed learning

There is need to reduce the search results to streamline it to the information being sought for by the learner and in order to solve this problem, this research focuses on developing a

visual semantic web ontology based e-learning management system.

## II. LITERATURE REVIEW

**Ontology-Based Data Integration (OBDI) Technique**

In computer science, ontology is a controlled vocabulary that describes objects and the relations between them in a formal way. Ontologies provide a sound basis for sharing domain knowledge between human and computer programs, or between computer programs. An ontology normally defines concepts (or classes), individuals (or instances), properties, relationships and their constraints. Logical formalization of ontology language ensures semantic interpretation, i.e. inference, by computer programs. Ontology is a major instrument toward realization of the Semantic Web vision (Rosse, 2013).Helena and Lidia (2009) defined ontology as a formal, explicit specification of a shared conceptualization and further defined conceptualization to be an abstract model of some phenomenon in the world by having identified the relevant concepts of that phenomenon. Explicit means that the type of concepts used, and the constraints on their use explicitly defined. Ontologies allow more complete and precise domain models. Ontologies intended to be shared and reused, and the approach is perceived to be beneficial. Ontology-based design has an advantage of being syntactically correct and semantically consistent as a model.
Vipul et al. (2008) Ontologies provide a common language to express the shared semantics and consensus knowledge developed in a domain. This research will explore this in its ontology-based integration technique phase. Ontology based Data Integration involves the use of ontology(s) to effectively combine data or information from multiple heterogeneous sources. It is one of the multiple data integration approaches and may classified as Global-As-View (GAV). The effectiveness of ontology based data integration closely tied to the consistency and expressivity of the ontology used in the integration process. (www.wikipedia.com, 2016)
Inter-application interoperability been long seen as schema mapping and data integration problem. In this manner, integration requires mapping systems and integration systems that uses those mappings to answer queries or translate data across data sources. There are three different categories of ontology-based integration approaches; single ontology approaches (SOIA), multiply ontology approaches (MOIA), hybrid ontology approaches (HOIA) (Bostjan and Vili, 2010)

**Single ontology approach:** A single ontology used as a global reference model in the system. The SIMS (Search in Multiple Sources) system is a prominent example of this approach. The Structured Knowledge Source Integration component of Research Cyc is another prominent example of this approach. (Title = Harnessing Cyc to Answer Clinical Researchers' Ad Hoc Queries)

**Multiple ontologies**: Multiple ontologies, each modelling an individual data source used in combination for integration. However, this approach is more flexible than the single ontology approach; it requires creation of mappings between the multiple ontologies. Ontology mapping is a challenging issue and is focus of large number of research efforts in computer science. The OBSERVER (Ontology Based System Enhanced with Relationship for Vocabulary heterogeneity Resolution) system is an example of this approach.

**Hybrid approaches**: The hybrid approach involves the use of multiple ontologies that subscribe to a common, top-level vocabulary. The top-level vocabulary defines the basic terms of the domain. Thus, the hybrid approach makes it easier to use multiple ontologies for integration in presence of the common vocabulary.
Ontologies enable the unambiguous identification of entities in heterogeneous information systems and assertion of applicable named relationships that connect these entities together. Specifically, ontologies play the following roles;

a. Content Explication: The ontology enables accurate interpretation of data from multiple sources through the explicit definition of terms and relationships in the ontology.
b. Query Model: In some systems like SIMS, the query formulated using the ontology as a global query schema.
c. Verification: The ontology verifies the mappings used to integrate data from multiple sources. These mappings may either be user specified or generated by a system. (www.wikipedia.com, 2016)

Ontology allows more complete and precise domain models. They intended to shared, reused and one of the main advantages of its design is that it has syntactically correct and semantically consistent model and reasoning over them provides retrieval of additional rules that were possibly not recognized during the design phase. The issue of structural difference in the data that data warehouse integrates and stores (relational databases, Object databases, unstructured data, etc) as well as when sources have the same structure but with data integration problem of synonyms and homonyms, ontologies are used to describe them as truly equivalent despite their appearing in different databases, forms and names (i.e. they describe the same objects. (Helena and Lidia, 2009)
In any domain such as that of business intelligence systems, ontology play the role of providing a common language to express the shared semantics and consensus knowledge developed in such domain. The shared semantics captured in the form of various domain specific ontologies and

classifications. The concepts provide the shared semantics to which various data objects and data interpretation mapped to enabling integration across multiple business intelligence data sources and domains. (Vipul et al., 2008)

After the 80s, the massive adoption of database systems inside organizations leads to the need to integrate different data repositories with possibly incompatible data schemata. The process of integrating different data residing at different sources to provide a unified view of this information known as data integration problem. As early stated in this research, data warehousing is one of the approaches to data integration problem solution. Here data originates from different sources and are submitted to a process called ETL (Extraction, Transformation and Loading) and the stored into a new database with a single and usually de-normalized schema. The resultant database often structured to store various aggregations of the sources' data in order to speedup query processing. Architecturally, data warehousing seen as a tightly coupled approach because the integrated data reside in a single place at query time. Recent approaches to data integration as would be found in our proposed research are sometimes "loosely coupled". (Letizia, 2016)

A data integration system provides a uniform interface to distributed and heterogeneous sources. These sources can be databases as well as unstructured information such as files, HTML pages, etc. One of the most important problems within data integration is the semantic heterogeneity, which analyzes the meaning of terms included in the different information sources. As earlier stated in this research, Data integration is concerned with unifying data that share some common semantics but originate from unrelated sources.

Heterogeneity classified into four categories: (1) structural heterogeneity, involving different data models; (2) syntactical heterogeneity, involving different languages and data representations; (3) systemic heterogeneity, involving hardware and operating systems; and (4) semantics heterogeneity, involving different concepts and their interpretations. The semantic heterogeneity deals with three types of concepts: the semantically equivalent concepts, the semantically unrelated concepts, and the semantically related concepts. In the first case – semantically equivalent concepts – a model uses different terms to refer the same concept, e.g. synonymous, or some properties modelled differently by different systems, for example, the concept length may be "meter" in one system and "mile" in one another. In the second case – semantically unrelated concepts – the same term may be used by different systems to denote completely different concepts; and in the last case – semantically related concepts – different classifications may be performed, for example one system classifies "person" as "male" and "female" and other system as "student" and "professor".

The main difference between ontology and a database schema is that the latter essentially constrains the possible states of the database, while the former has typically a model theoretic semantics and thus allows inferring new knowledge (in a deductive fashion).

With the use of ontology the following advantages is feasible when used for data integration, which are;

(1) The vocabulary provided by the ontology serves as a stable conceptual interface to the databases and is independent of the database schemas,
(2) The language used by the ontology is expressive enough to address the complexity of queries typical of decision-support applications,
(3) Knowledge represented by the ontology is sufficiently comprehensive to support translation of all the relevant information sources into its common frame of reference, and
(4) The ontology supports consistent management and recognition of inconsistent data.

Ontology gives the name and the description of the domain specific entities by using predicates that represent relationships between these entities. The ontology provides a vocabulary to represent and communicate domain knowledge along with a set of relationships containing the vocabulary's terms at a conceptual level. It is therefore possible to use ontology for data integration tasks.

The features for the building of the ontologies defined in the system divided into three sub-features reusability, changeability and scalability. Reusability refers to the ability of reuse the ontologies, that is, ontologies defined to solve other problems used in the system because of either the systems support different ontological languages and/or defines local ontologies. Changeability refers to the ability of changing some structures within an information source, without producing substantial changes in the system components. Finally, scalability refers to how easy the integrated system extended with new information sources. In general, the systems use languages based on Description Logics, although some Web–based languages (OWL) have recently emerged and is quite better, (Augustina et al., 2014).

The interoperability of a system is seen consequence of technical, semantic, organizational, legal and political tools. It empowers transfer and usage of data in other information resources such as;

- Organizational. It specifies the regulation of resource interaction.
- Technical. It describes the compatibility of Information Technology (IT) tools, establishment and usage of open interfaces, standards and protocols in order to ensure effective data exchange.
- Semantic. This characteristic ensures that data from one information system understood and interpreted in the same way in other systems.

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Systems must be able to exchange data. Data exchange between information systems determined by reciprocal agreements, which are different in each case: web-based services, open standards, specifications. Direct data integration is impossible if data processed by applied information system logic. This process performed in real time in source system changes occur, fixed time intervals automatically or manually, using popular methods: Extract, Transform and Load (ETL), data replication, federation, event-based integration, web-based technologies and open standards. The aforementioned methods have essential disadvantages in the context of heterogeneous DBMS (Database Management System): the problems of automatic update neither considered nor solved; the same data is stored in several sources. Besides, there is no possibility to get data or information messages on databases using direct access interaction. The researchers of distributed heterogeneous databases have applied ontologies to support semantic interoperability: to integrate data sources developed using different vocabularies and to see data from a different perspective. The proposed ontology-based data integration phase of our business intelligence system hopes to automatically perform data extraction and integration from structured, semi-structured and unstructured data sources. (Virginija and Rimantas, 2011)
Normally, the organizational data resides in multiple data sources. For typical business intelligence (BI) data integration projects, the design and development of data integration processes involve collecting facts for the integration, analyzing data structures and their descriptions. However, it is inappropriate to focus on the management of data requirements only: it is very important to discern that integration is more than data. It also covers:

**Data sources:** what data from where has to be integrated?

**Business rules (BR):** which BRs have evaluated for data processing and keeping in data sources?

**Transformations:** which transformations done in order to avoid structural and semantic conflicts?
The integration of data ensures data management in the way that they unambiguously identified in information system (IS) and it is possible to transfer, transform, load and use them in other information system (IS) or source without changing program code. Ontology-guided data integration makes the process more efficient – reducing the cost, maintenance and risk of the project.
Again, the term "ontology" refers to a machine-readable representation of knowledge, particularly for automated inference. Ontology is a data model consists of these parts: classes, properties and relationships between them. The power of ontologies lies in the ability to represent relationships between the classes. The main benefit of using the ontology-based model is its runtime interpretation. One of the major advantages of the ontology model is an assumption of open-world. The reason for the popularity clearly interpreted dissemination of knowledge between people and applications. Moreover, ontology supports the integration task as it describes the exact content and semantics of these data sources more explicitly. One ensures that if a highly descriptive semantic representation of the available knowledge could built; it could be reused to power a variety of business applications without the need for repeated integration exercises. Furthermore, the new knowledge gathered from different sources can build upon the current knowledge because all of it exists in a semantically consistent system. Thus, we conclude that knowledge is the foundation of all successful decisions. (Virginija and Rimantas, 2011)

An overview of the requirements, which automatically satisfied by an ontology-based process, is given in figure 1.

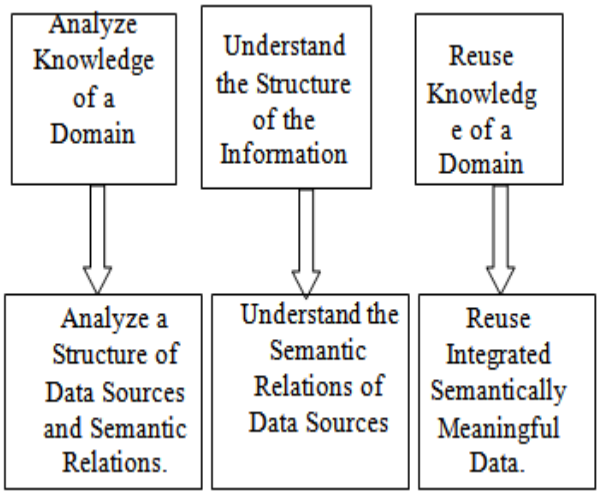


**Fig.1:** Transformation of Ontologies Features to Data Integration Systems Requirements (Virginija and Rimantas, 2011).

Rabiman et al., (2020) in their work said that the unpreparedness of educators and students in the learning process becomes weakness in traditional learning. Moreover, teaching material delivered cannot be repeated while the small notes and educator explanations have limitations in knowledge transfer. This method is ineffective and has limited learning space and time that cannot be accessed anytime and anywhere. Therefore, the research aims to produce an LMS-based E-Learning system tested on Microteaching in the Mechanical Engineering Education class. The research method adopts the Hannafin and Peck approach model with specific phases (needs analysis, design, development and implementation). Media experts and material experts according to their capabilities validated the developed LMS. The results of LMS-based E-Learning

development research was "very feasible" to be used. The assessment based on the LMS usability, LMS functions, visual communication, learning design, material contents, as well as language and communication. The research was narrowed to a single department and does not have wide coverage which is the research gap created.

Eman (2019) said that mobile technologies offer a possible solution for applying technology in education in developing countries, as it offers solutions to specific developing countries infrastructure limitations. Mobile devices, such as smart phones and personal digital assistants (PDAs) used as learning organizer tools and for delivering online courses to university students. Mobile technology enhanced learning pertains to the delivery of multimedia learning resource onto mobile end devices such as cell phones and PDAs. It also aims to support personalized adaptive learning in a community context. So in the work, design and implementation of an m-learning application presented. The work focus on adapting content presentation to select elements from various sources in a mobile environment, such as elements from the learner's profile, mobile device requirements and connectivity's. This ensures that the learner can manage and get the content through the mobile device and it environment. The framework of the project used to represent the approach for data representation to reduce the complexity of the learning environment, allows efficient content adaptation, and applied to any type of learning content; the work only takes into account material that supports learning, such as summery, quizzes, messages, objective and comment and so on. Moreover, the proposed model supports the student-learning context, which is a result of the mobility of m-learning scenarios such as user location, movement, and duration of stay, noise level and availability of resources. The word did not include search function to the system, to allow the learners to search for lectures, subject or anything else.

Sareh et al., (2020) proposed a translational research design focusing on adaptation of educational technology and conducted in three stages: Preparation, implementation, and assessment. In the preparation stage, they matched LMS with technical support requirements. In the experimental stage, the effectiveness of a web-based system (LMS) for thesis support assessed. In the post- experimental stage, the program assessed using quality criteria. The data analyzed by descriptive statistics (mean and standard deviation), analysis of variance (ANOVA), and post-hoc tests. The results of students' perspective showed that the scores of the quality criteria after using LMS in comparison other alternative methods were at the desirable level. Thou the work did not include multimedia in their learning facilities.

Muhardi et al. (2020) is of the opinion that Learning Management System appears as a solution to the many problems that arise due to limited time, place and the number of meetings between teacher and student. Learning Management System as a tool in the learning process offers several advantages so that it can solve problems that often arise in the learning process. Based on the limited number and time of meetings, a web-based Learning Management System built by using the PHP programming language and MySQL Using the Waterfall Model Method. The result has been developed a Learning Management System with facilities as a medium for the dissemination of subject matter, media for the distribution of assignments, and as a media for student discussion forums. In this Learning Management System application has actors; admin, teachers, students. The admin has the duty as an e-learning application manager to manage the application so that it can run well. The admin manages curriculum data, semester years, teachers, students, subjects. The teacher gives the material and assignments done by students, while students will work on assignments uploaded by the teacher and download the material uploaded by the teacher. Learning Management System application as a support for learning activities, because schools are able to carry out learning activities not only teaching in the classroom. By creating learning media through the Learning Management System website, teacher and student interaction increased.

Ahmad and Tanika(2015) proposed development of E-Learning system to support teaching and learning activities. The main objective was to design E-Learning system in teaching and learning process at Industrial Engineering Department of Swiss German University, by using Dynamic System Development Method (DSDM). The result shows that the teaching and learning processes improved by integrating the developed E-Learning system including its specific interfaces and platform. It also shows that the developed system accepted by potential users, as indicated by the user acceptance test. The e learning system developed did not integrate multi-media for learning enhancement. From the review, it stated that E-Learning is associated with any learning process that incorporated any form of technology. E Learning defined as all that activity utilizing information transfer and knowledge utilization during the learning process with particular attention to computer-based technology involving learning activities (Khan, 2015). While learning management system (LMS) as software that permits the administration and facilitation of a variety of learning and training events and amenities (Rodriques et al., 2020). In traditional instructive system, learning management systems can help enhance the speed and efficiency of the instructive procedures, interaction within learners and between teachers and learners (Som, 2013). Some e-learning management platforms have been in existence and some authors proposed an E-Learning personalization based on hybrid recommendation strategy and learning style identification. Other studies also focused on the representational issues of learning design, which describes the method that enables the learners to achieve the learning objectives after carrying out a set of activities, using the resources of an environment. In addition, the

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review shows that some authors proposed developing an adaptive e-Learning software to enable the learner answer questions or solve problems based on his/her ability.
In all the literatures reviewed, the authors failed to address the problem that arises in a situation where the learning materials suggested to the learners by the e-learning system may not suit the interest of the learners, therefore this makes learning not interesting. In addition, most of the existing system does not include all the major components of LMS, which are the course management, student management, feedback management, material management, online exams, and assignment assessment. This forms the research gap this thesis is to address.

## III. MATERIALS & METHODS

Object-Oriented Analysis and Design Methodology (OOADM) is a technical approach for analyzing and designing an application, system, or business by applying object-oriented programming, as well as using visual modeling throughout the software development process to guide stakeholder communication and product quality. In modern software engineering, Object-oriented analysis and design methodology typically conducted in an iterative and incremental way. The outputs of OOAD activities are analysis models (for OOA) and design models (for OOD) respectively. The intention is for these to be continuously and evolved, driven by key factors like risks and business value. The very nature of this system, in which navigation combined with the inherent difficulties of dealing with multimedia data, needs an OOADM approach. The interface of Web apps is more complex than in traditional software systems, navigation and functionality should be seamlessly integrated and the navigational structure should be decoupled from the domain model of the app, therefore OOADM was chosen for its functionalities, in that it allows object oriented abstractions for analysis and design of information-intensive web applications. Besides the modeling abstractions, it also provides a methodology, which guides a developer through different activities in the web application development. Unlike Structured System Analysis and Design Methodology (SSADM), the object-oriented approach combines data and processes (termed Methods) into single entities termed objects. Object usually corresponds to the real things a system deals with, such as customers, suppliers, contracts and invoices. These models Object-Oriented Analysis and Design Methodology (OOADM) thoroughly represent complex relationships to represent data and data processing with a reliable notation that allows an easier mix of analysis and design in a growth process. The aim of this Object-Oriented Analysis and Design Methodology (OOADM) is to make system elements modular, thus improving system quality and efficiency of systems analysis and design. The focus on this model tends more towards the behavior of the system and the main feature documented here is the class and object. This methodology applied to this work as the research intends to bring to light the behavior in terms of benefits when ontology-based and virtual data integration techniques applied in e-learning management system.

## IV. OBJECT- DESIGN MODELS

**Use Case Diagram**

The model designed in this paper divided into several modules that needs access restrictions. Different use case described in the way they were applicable in the software designed. Use cases are as listed below:

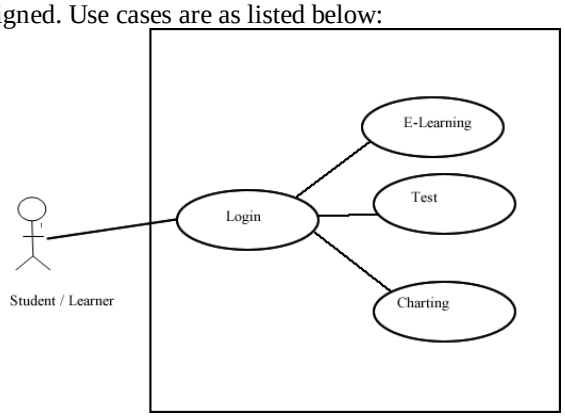


**Fig. 2:** Student/ Leaner use case diagram

Figure 2 shows the use case diagram for the learners. They can search for learning materials, undergo test for performance evaluation and engage in charting

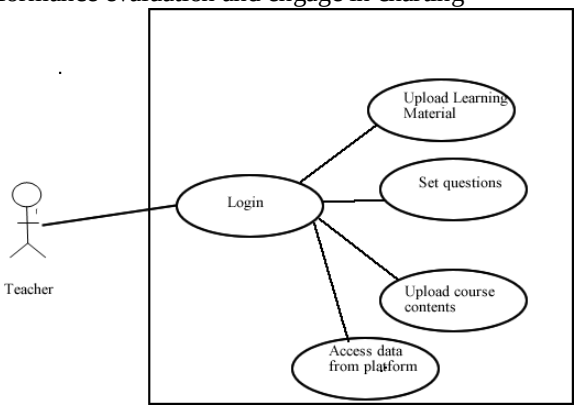


**Fig. 3:** Teachers / lecturers use case diagram

Figure 3 is the use case diagram for teachers / lecturers. They upload learning materials, set test questions, and access data from the e-learning platform.

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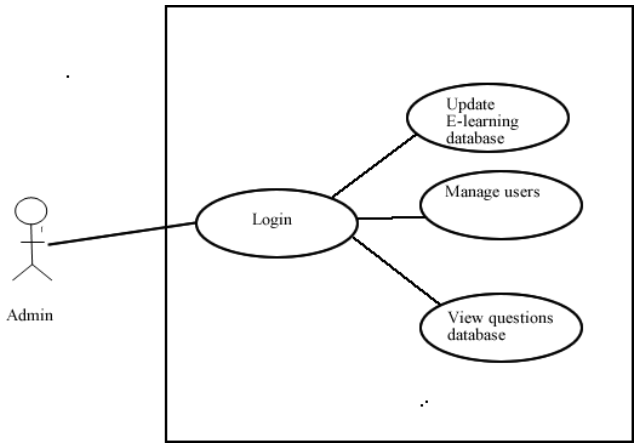


**Fig. 4:** Admin use case diagram

Figure 4 shows that the admin can view the e-learning database update the database and manage users.

**Interaction Diagram**

Based on the gathered information through our research methodology, the main challenge of e-learning systems are efficiency and relevancy of the results. To meet these challenges, this section presents "visual semantic web ontology-based e-Learning management system's Framework". It has been developed using web services, an ontology and agent components. In the following subsections, based on e-learning standards we describe how the proposed e-learning model interacts(figure 5). The system is presented below, an architecture overview of our approach that focuses on the definition of abstract services, web services instances, LOM, XML, RDF, OWL and the user's expected goals. The system defines three main layers interface, service integration and management. The aim of the framework is to provide an integration service platform that offers learner-centric support for web-based learning, which will improve the efficiency of the e-Learning applications and as well the relevancy of the search results. The new system has proposed using web services, an ontology and agent components.

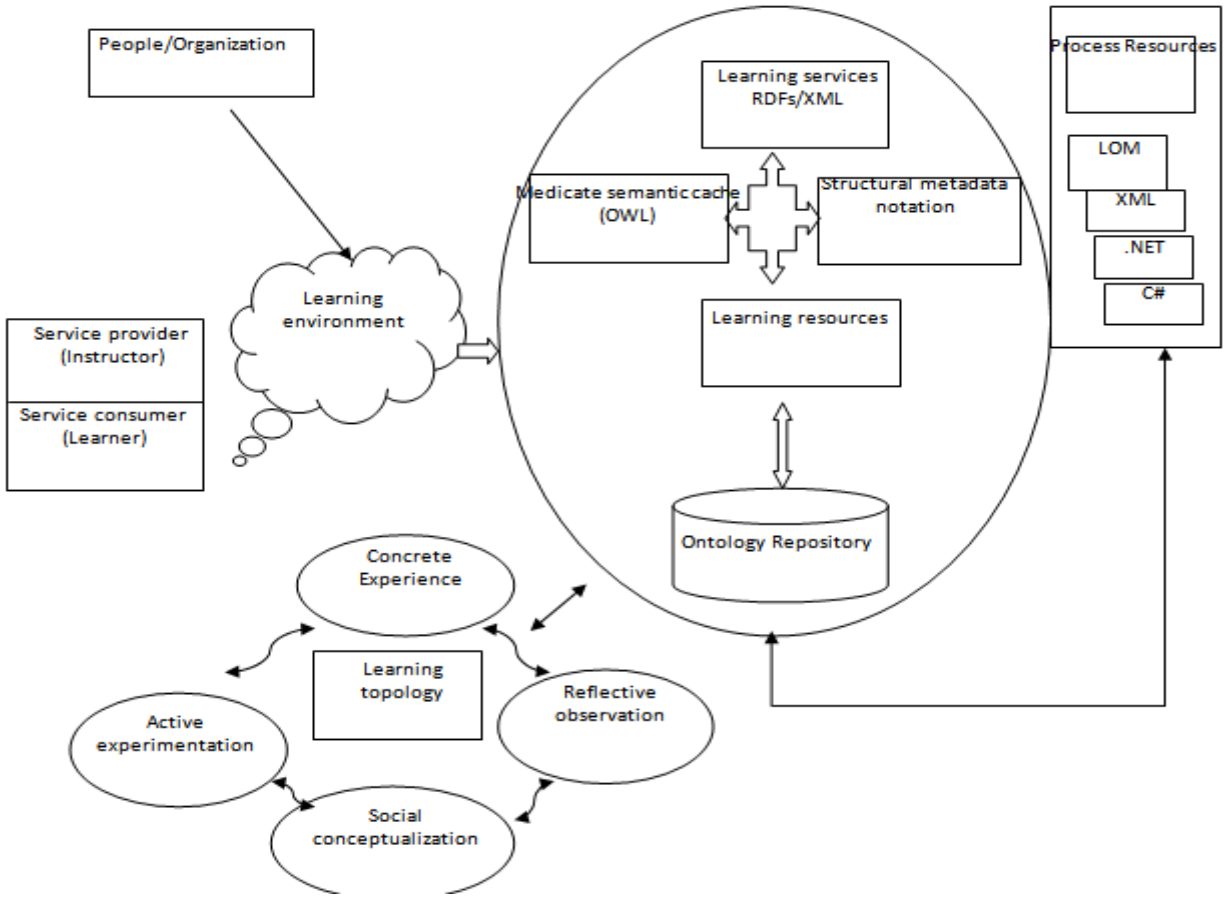


**Figure.5:** Visual semantic web ontology-based e-Learning management system's Framework

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The e-learning management system-using learner or instructor system, designed as a web-based data transmission system. In learning system, a learner has to perform different functions when he tries to access the system. First of all a learner need to log in the system if he is already a member of the system otherwise he need to register in the system to fill the information about him so that he can access the system next time. A learner has to select the course to learn. Take the quiz and get marks on it, and the mark determines if to continue with the course or prerequisite course is to recommended. Log out the system if the learner wants to exit the system. The instructor side uploads the information such as to add the new courses, course outline, quizzes and exams. Admin side keeps the student record in his database and can edit the data if required.

**Sequence Diagram**

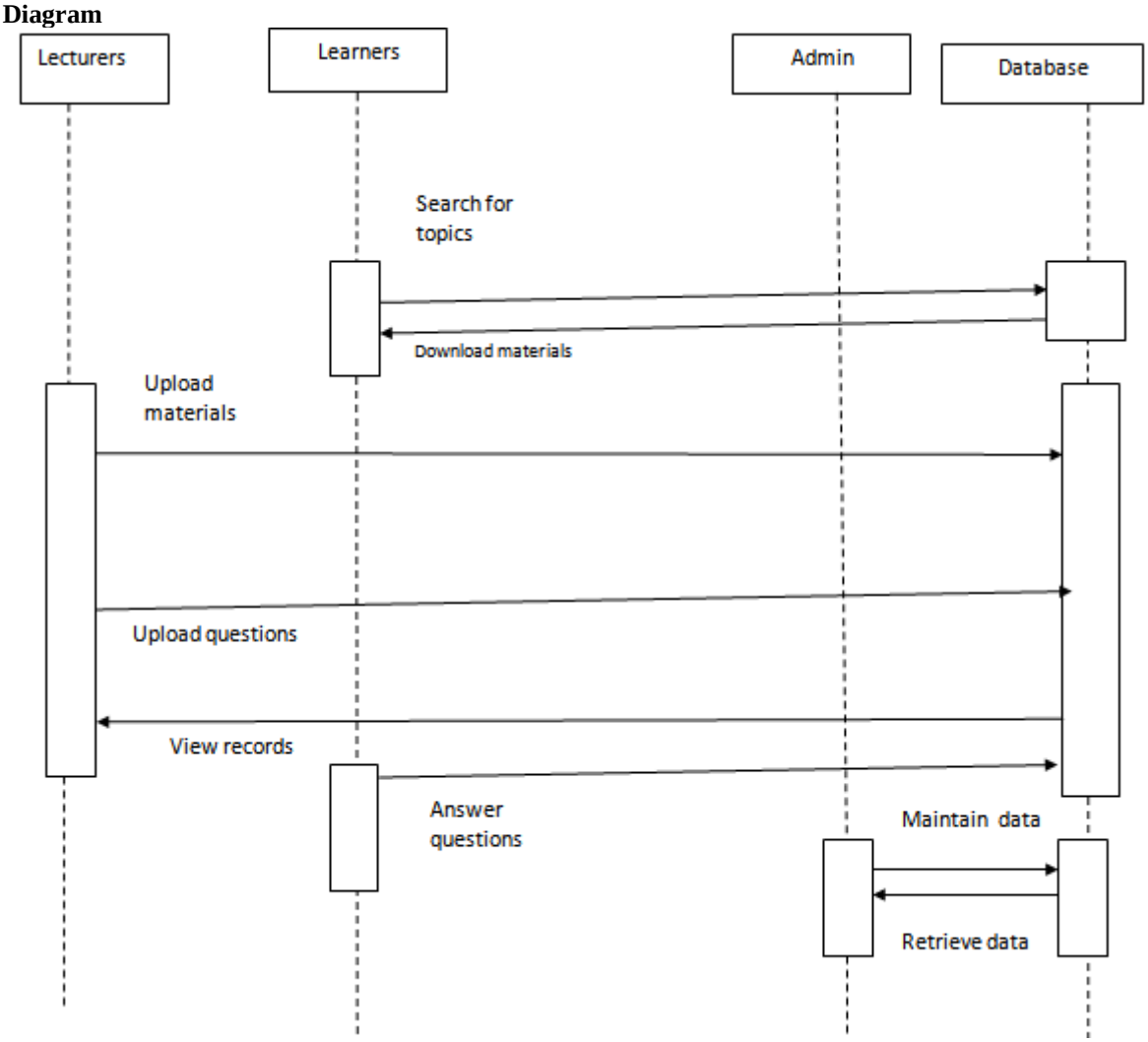


**Figure. 6**: Sequence diagram of the proposed system

The sequence diagram in figure6 shows how objects interact with one another and in what order. It depicts the objects and classes involved in the scenario.

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**Activity Diagram**

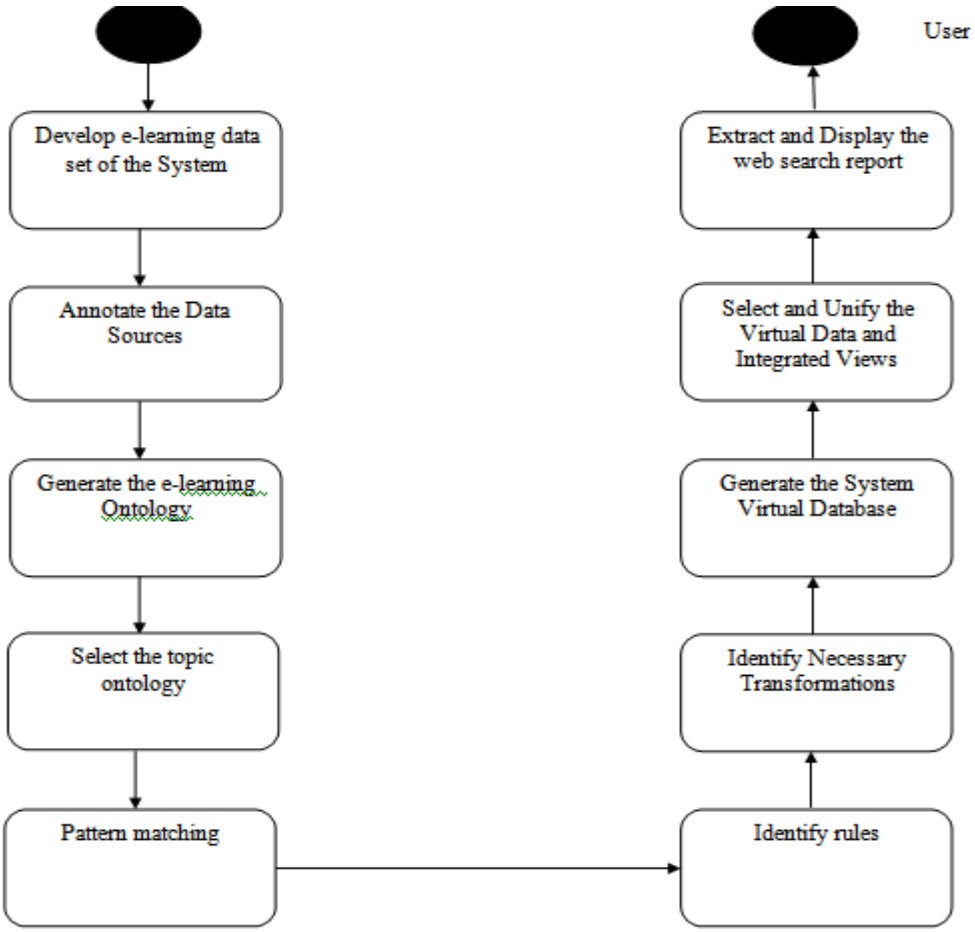


**Figure 7:** Activity Diagram of the proposed system

The activity diagram of the proposed system as shown in Figure 7 entails the ontology-based and visual semantic data integration process. The process flow of the system would be boosted with the software agents as indicated in the data integration layer of the system design. The data integration layer is where the ontology-based and virtual semantic data integration process takes place.

**Class Diagram**

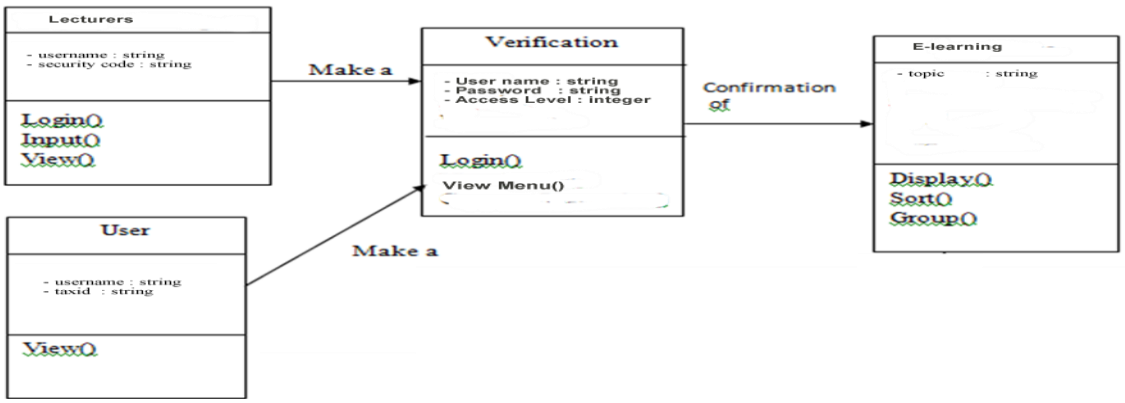


**Figure 8:** Class diagram of the proposed system

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Figure 8 shows the class diagram of the model e-learning management system. Class diagrams are one of the most useful types of diagrams in UML as they clearly map out the structure of a particular system by modeling its classes, attributes, operations, and relationships between objects. The standard class diagram is composed of three sections:

- **Upper section:** Contains the name of the class. This section is always required, whether you are talking about the classifier or an object.
- **Middle section:** Contains the attributes of the class. Use this section to describe the qualities of the class. This is only required when describing a specific instance of a class.
- **Bottom section:** Includes class operations (methods). Displayed in list format, each operation takes up its own line. The operations describe how a class interacts with data.

## V. RESULT

Confusion matrix applied to test dataset of e-learning using both Ontology-based data integration technique and Virtual data integration technique.

| | | **Observed** | |
|---|---|---|---|
| | | **True** | **False** |
| Predicted | **True** | 18 | 0 |
| | **False** | 1 | 1 |

Table 1 shows that out of 20-web search conducted, 18search results are True Positive and were able to return the needed materials correctly. One web search detected to be False Negative while it is not as nothing returned. Finally, one False Positive detected. A model of performance metrics derived from the confusion matrix as show in equation 4.3, which show the accuracy of the system.

Substituting the values, we have
AC = (18+1) / (18+0+1+1)
AC = 0.95 i.e. 95% accuracy in returning the correct needed materials in the web search on the e-learning platform.

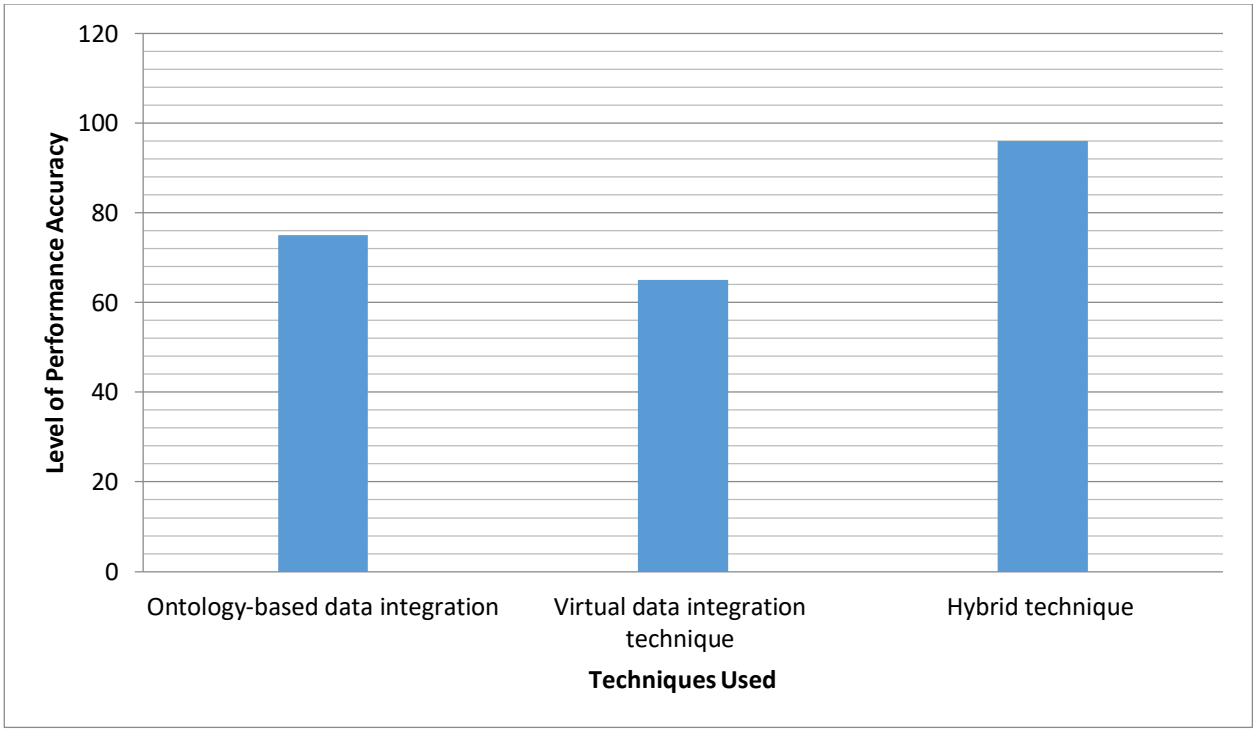


**Figure 9:** Comparison of level of performance accuracy using various techniques

From figure 9, we can see that the Ontology-based data integration technique has 75% accuracy; Virtual data integration technique has 65% accuracy; while Hybrid technique using both Ontology-based data integration and virtual data integration technique has 95% accuracy in returning the desired web search result. This shows that the Hybrid technique outperforms the existing techniques with (95 – 75) 20%, i.e. there is 20% improvement from the existing technique.

## VI. CONCLUSION

With the advent of technology, learning systems are facing rapid changes with the advent of semantic web technologies, and intelligent learning applications are becoming possible with the development of ontologies. In this thesis, Learning Management System (LMS) implemented using ontologies. The domain ontology facilitates the learner with granular learning content, whereas the task ontology facilitates the system to perform various functionalities. The personalization of data done by making use of the domain and task ontology and, therefore, the system is capable of recommending appropriate resources to the learner. The system is capable of handling the courses of other domains simultaneously as the system is highly scalable, provided the course added uploaded in the database, for the unification and standardization of ontology. A feedback system implemented for each resource provided by the system. Such system helps tutors and learners to interact real time. This helps the system to provide the most appropriate resource for the learner.

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