JETIR.ORG ISSN: 2349-5162 | ESTD Year : 2014 | Monthly Issue
JOURNAL OF EMERGING TECHNOLOGIES AND INNOVATIVE RESEARCH (JETIR)
An International Scholarly Open Access, Peer-reviewed, Refereed Journal

A FRAMEWORK FOR EVALUATING ADAPTIVE E-LEARNING PLATFORM IN HIGHER EDUCATION.

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Abstract.

An emerging method in education and learning is e-learning. The goal of adaptive e-learning is to recognize each person's unique learning style and skill set and adjust accordingly. Further offers a way to analyze the behavioral learning pattern and offers thorough performance and skill mapping, allowing users to recognize the areas in which they need to develop. In a proposed personalized e-learning framework, learning objects are categorized based on how well they suit various learning types and styles. The learning objects are then made available to individual learners based on their requirements, preferences, and skill levels. In order to do this, the learner's knowledge level for each domain idea in the learning material is determined and updated. In particular, every time the student's understanding of a domain idea shifts, the way that a learner's understanding of connected topics changes must also be inferred by the system. By doing this, the system determines whether or not the student is learning, and if so, it modifies the learning material delivery to match the needs and learning speed of each individual learner.

Key words; E-learning, Adaptive, Personalized, Domain, Framework, Emerging, Objects.

1. Introduction

From one instructional design for numerous learners to one design for each student or several designs for each learner, instructional design has changed in e-learning environments. It is a truth that different learners learn in different ways and that these differences impact how they learn best. Many learning sequences for the same course employing various course components should be established in order to meet this goal. The design of these components must be self-contained and compact enough to allow for reuse in a variety of settings if they are to be considered reusable. In this view, a vast number of components will be generated; the challenge will be in identifying the necessary components and placing them in the proper order inside the intended learning sequence, a learning management system to assess behaviour (Daminda & Lashman, 2018, Samar, 2016).

Each component must be labeled with information identifying its various features, such as its subject matter and other characteristics that make up each of these components, in order to make the process of searching for learning components easier. To facilitate their sharing and reuse within the community of learning course creators, the generated learning components must follow a common model. It is also necessary to unify the terminology and vocabulary used to define the learning components. Alhawiti and Abdelhamid (2017) state that in order for machines to assist the authors in creating learning sequences, component and property data needs to be modeled and stored in a form that can be exchanged by machines. An intelligent procedure that compares the attributes of the various learning components to those of the individual students is required. This procedure will make use of its understanding of the traits of learners to assist them in customizing the learning plan to their liking. The authors think that the existing information technologies can meet the above needs, despite the fact that it's a complex operation. There are four steps involved in using these technologies: delivery, feedback, characterization, and authoring. The course designer needs a mechanism to assist in creating the content during the authoring stage. The best tool for this stage is a learning content management system (LCMS), which gives the course designer all the writing and design tools they need to create and arrange their material. Learning objects are described, tagged, and classified at the characterization stage, which makes it possible for them to be shared or used again in multiple courses. By explicitly defining its properties, ontology offers the ability to officially characterize learning objects. This will make it possible to establish the vocabulary that will be used later on in the delivery stage to match the learner's personal traits, abilities, and preferences with the qualities of learning objects and recommend the best learning objects for them. Lastly, in order to develop the knowledge upon which particular learning items are suggested for each unique learner, either based on the learner's prior choices and preferences or based on those of other learners who share their interests(Alhawiti & Abdelhamid, 2017)

1.2. Background.

Adaptive learning system is a technique that increase the efficacy of an e-learning system by customizing the material presentation and overall connection structure to each user based on their knowledge and behavior. Individual learning characteristics allow some students to explain why they find online learning easy, while others find it challenging. (Li & Liu, 2024)Three models make up the adaptive learning system; learner, domain, and adaptation. The learner model is in charge of maintaining data regarding the knowledge levels and learning preferences of each student as well as updating the interactions and test results on a regular basis. Information regarding what subjects and materials should be taught to the learner is gathered or compiled at the domain level. The adaptation model focuses on the process and timing of adaptation. (Alhawiti & Abdelhamid, 2017)With the use of current technology, an e-learning environment could be created that can construct and manage sharable and reusable semantically modeled learning entities, gather learner preferences, and provide personalized e-learning services based on the preferences and personal traits of each individual learner. Semantic web, ontology, learning objects, and content management systems are these technologies. Not only will the notion of e-learning personalization be introduced, but the reader will also receive sufficient explanations of each of these technologies and their functions within the suggested framework (Alhawiti & Abdelhamid, 2017) Li and Liu (2024) concluded that personalized process with technology could be an alternative and effective approach to suit the learners' needs and abilities(Li & Liu, 2024)

Adaptive e-learning has gained popularity in recent times, research onto offer a customized e-learning experience, Faisal et al. (2015) presented a novel adaptive e-learning architecture that makes use of recommender systems and crowdsourcing. Preparing and presenting the learning content includes crowdsourcing. Additionally, to facilitate lesson customization, the framework incorporates a recommender system to collect formative feedback from the students (Faisal et al., 2015). Personalized learning inspires students and increases their engagement and participation in the course. In order to increase learners' academic performance and cognitive development processes, studies will be carried out in the future to assess the efficacy of the suggested framework (Faisal et al., 2015)

2.0E Learning.

The usage of e-learning in education has grown significantly since the mid-1990s. E-learning is generally understood to be "the use of telecommunication technology to deliver information for education and training," while scholars on the subject disagree on how to define it.In a variety of organizations, including corporations and higher education institutions, there has been a strong demand for e-learning due to the need for it to provide a personalized learning environment that can adjust to the learning preferences of the students and intelligently suggest learning resources (Riad et al., 2023)

2.1 Learning Styles

An individual's learning style is determined by their attitude and behavior; according to Honey & Mumford's theory of learning style, individuals are categorized based on the level of activities at each stage; pragmatists and activists perform best in face-to-face interactions; reflexive and theoretical people tend to perform best in online environments; and all of these factors must be taken into account for effective teaching El-Sabagh (2021)An e-learning platform's course instructional delivery design should include activities that satisfy the needs of all student categories. Students typically do better when given the chance to actively participate in the process (Abhirami & Devi, 2021) It offers more time for exploration and knowledge and skill expansion. Reviews, course-related practice activities, and discussion forums are ideal for the "active learner" category. Those that are reflexive like to observe and reflect. In accordance with their perceived experiences, reflexive learners typically advance. For e-learning platforms to encourage reflective learners, films and examples are essential (Griffiths, 2022) Those who are pragmatic learners like to try out theories, concepts, and methods. From ideation to realization, they would rather take their time. Pragmatist learners benefit from experimental exercises such as simulations. The Felder-Silverman learning style model states that depending on personal preferences, people process and absorb information in different ways. To illustrate various learning preferences and styles, Felder et al. created a model. The model states that four aspects of personality influence the learning process. They are verbal or visual, sequential or global, sensory or intuitive, active or reflective (Abhirami & Devi, 2021)

2.2 Current Adaptive e-learning system architecture.

Adaptive e- Learning System, according to Li, Y., & Liu, Z. (2024a), provides a platform for the use of mapping, scaffolding, and interactive learning, which stimulates students' potential for independent learning and helps to improve their ability to learn independently The efficiency of e-learning systems has been developed and enhanced using a variety of traditional paradigms. One is predicated on service-oriented architectures (SOA), which make it simple to add services dynamically to increase the system's functionality and capabilities. The data layer, resource layer, application layer, business process layer, presentation layer, and governance layer are the six components that make up the SOA system architecture and reference for an e-learning system, for instance, as presented by Fajar et al. (2018). In the SOA system, each layer's data is handled as a service, increasing its reusability, flexibility, and accessibility to other tools. This approach enables companies and the public to enhance e-learning and provide reasonably priced education (González et al.2009)

The architecture offers dependable data interchange and interoperability between e-learning platforms, mobile apps, and external apps while guaranteeing their independence. Additionally, in order to satisfy the needs of diverse e-learning situations, Kappe and Scerbakov (2017) offer a novel object-oriented architecture for the creation of e-learning systems on a single software platform. Abstract data objects (ADOs), which contain private memory along with certain techniques, are frequently utilized as the primary constituents of functional objects such as curriculum, announcements, courses, and so on. Because documents and objects can be created individually and then reused through a flexible containment or layering mechanism, the implementation demonstrates how extremely modular this design is (Kappe and Scerbakov 2017)

We draw a broad framework for contemporary e-learning systems based on prior research, which essentially consists of three logical levels that improve the efficacy of teaching and learning: the presentation layer, the e-learning system layer, and the data layer. This interface is how the e-learning system layer provides feedback. According to Schuck et al. (2017), the presentation layer should make sure that e-learning systems support the mobile learning paradigm (Liu & Yu, 2022b)

3.0Three layered e-learning system Framework.

Presentation layer: This layer in figure 1, shows the end-user interface, allowing communication between the user and the systems. It is used for presenting information and allowing users to interact easily with the educational recommender system. At every stage of e-learning, interaction occurs in different levels between the users. Every action provides inputs to understand the user. Course enrollment captures the basic data about a learner such as age, gender, qualification, work nature etc. Pre-requisite tests and pre-assessment tests help to understand a user's knowledge level before undergoing the course. At the end of chapters/session, the evaluation exercises tests the progress of learners. Post-assessment test, at the end of the course, helps in identifying the overall development of the learner(Alhawiti & Abdelhamid, 2017)

The vital parameters in course log file includes access duration, visits, date and clickstream patterns, which altogether help in understanding the learner. A user's timely submission of assignments and attempting assessments on schedule indicate their progress and commitment level. Learner coverage schedule is another important parameter in user identification. Based on these parameters, user profiling is done. The learner layer thus captures the data to perform behavior modeling(Liu & Yu, 2022b)

Services layer: This layer has the recommendation algorithm that contains the metrics and algorithms for the generation of recommendations. The selection of the similarity metric is based over an analysis of several available metrics that are useful according to the data type. layer provides approaches to instruction and evaluation based on user behavior analysis. The learning activities are designed to facilitate the understanding and modeling of user behavior. Its activities include topic-oriented tasks with deadline, which motivates the learner to actively participate throughout the course path (Liu & Yu, 2022)

Data Layer- stores information about the metadata educational resource provided by the educational recommender systems (video, books, and images, among others) for a certain subject.in our case HCI.This layer we have the HCI subject for as the educational resource. The learning activities are designed to facilitate the understanding and modeling of user behavior. Its activities include topic-oriented tasks with deadline, which motivates the learner to actively participate throughout the course path (Liu & Yu, 2022)

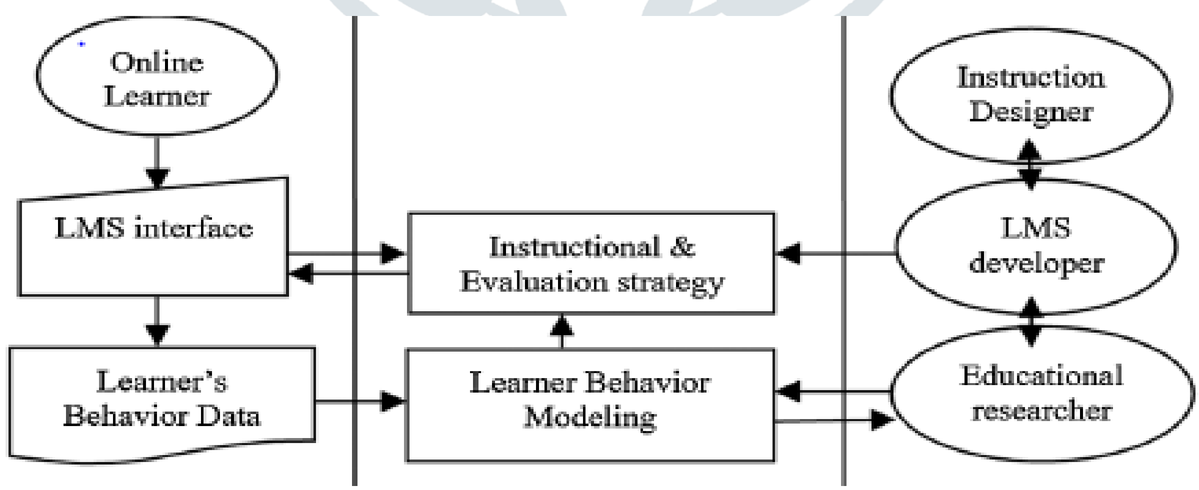

Figure 1: Three layered adaptive e-learning system Framework.

3.1 Summary

In figure 1, shown which indicates a three-layered e-learning system framework, the Learner layer shows the end-user interface, allowing communication between the user and the systems. The parameters in course log file includes access duration, visits, and date and clickstream patterns, which altogether help in understanding the learner and are very vital, thus captures the data to perform behavior modeling. The second layer which is the service layer contains the Algorithms/developed classification model that facilitate the understanding and modeling of user behavior through the learning path and learning styles of the learner. After understanding the learners profile and the behavior, modelling it recommends the personalized material in our case the HCI as the subject registered by the student. The subject is stored in the expert/Data layer that is used by the learner after recommendation has being done.

3.2 Current Trends.

Today's e-learning has developed into a multidisciplinary process that encompasses psychology, pedagogy, computer science, and many other engineering disciplines. These developments take into account both pedagogical and technological considerations. To transform traditional in-class instruction into competency-based education, ideas like blended learning and adaptive learning have been proposed. Additionally, a vast amount of data has been produced as a result of the widespread usage of e-learning systems. We can improve the teaching and learning process by using data-intensive methods to educational resources to gain a better knowledge of learners, educational environments, and educational outcomes(Liu & Yu, 2022b)

The way we approach teaching and learning is being altered by eLearning trends in the quickly evolving field of education (Enache, Maria, 2023; Alfaro et al., 2021). The learning environment is about to undergo a transformation thanks to a number of important factors.

The first trend is a hybrid approach to education called blended learning. Instructor-led and on-demand learning are integrated into a cohesive training approach. It is necessary to strike a balance between eLearning, independent self-study, and conventional instructor-led instruction when using a mixed paradigm (Shetu et al., 2021). The most significant benefit of combining these teaching philosophies is that it gives business education more flexibility. Another tendency that is unavoidable given that every kid learns differently is personalization. However, customization must take into account each person's demands, requirements, learning objectives, and degree of expertise (Mistretta, 2024)

3.3 Adaptive Learning.

Adaptive learning is a technique to use data-driven instruction to adjust and tailor learning experiences to meet the individual needs of each student. Adaptive learning systems can track data such as student progress, engagement, and performance, and use the data to provide personalized learning experiences. Adaptive e-learning is viewed as stimulation to support learning and improve student engagement, so designing appropriate adaptive e-learning environments contributes to personalizing instruction to reinforce learning outcomes (El-Sabagh, 2021)

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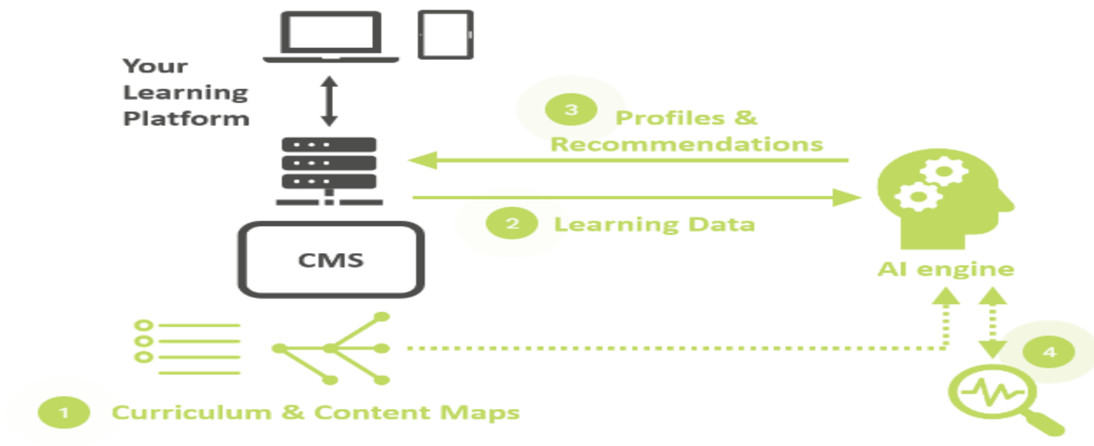

Figure 2: Adaptive Learning Process.

3.4 Adaptive Approach.

According to Li, Y., & Liu, Z. (2024a), the Adaptive Learning System offers a platform for the application of interactive learning, scaffolding, and mapping, which encourages students' potential for independent learning and aids in enhancing their capacity for independent learning. This enhances students' ability to think independently, solve problems, express themselves, and make judgment calls in conversation—all of which are beneficial to their overall growth (Li, Y., & Liu, Z. 2024a).

3Table 1: Attributes of Adaptive E-learning Framework.

Attributes of E-Learning	Description
1.Institutional	Administrative, academic, and student services challenges pertaining to online education are the focus of the institutional dimension.
2.Management	Information dissemination and learning environment maintenance are considered aspects of e-learning management.
3.Technological	The technical aspect of e-learning looks at problems with the infrastructure of technology in e-learning settings. This covers hardware, software, and infrastructure planning.
4.Interface design	The general appearance and feel of e-learning applications is referred to as the interface

	design. Page and site design, content design, navigation, accessibility, and usability testing are all included in the interface design dimension.
5.Pedagogical	In e-learning, teaching and learning are referred to as the pedagogical dimension. Issues pertaining to design approach, organization, learning methodologies, audience, objective, and media analyses are covered by this dimension
6.Ethical	Social and political impact, cultural diversity, bias, regional variety, learner diversity, the digital gap, etiquette, and legal concerns are all related to the ethical considerations of online education.
7.Resource support	The online resources and support needed to promote meaningful learning are examined by the e-learning's resource support component.
8.Evaluation	The evaluation for e-learning includes both assessment of learners and evaluation of the instruction and learning environment.
9.Adaptive Model	Machine learning algorithms that can be applied to enhance the intelligence and capabilities of improving learning experience in e-learning platforms.

3 Discussion

Different learning sequences are required for learners with varying learning styles in order to improve their performance during the learning process. If correctly integrated, current information and e-learning technologies can accommodate varied instructional designs for various learners. Learning objects and learning management systems have existed for a long time, because the developers of e-learning courses must put in a great deal of labor, the personalization requirement could not be met.

This study tackles this need by presenting ontology and semantic web technologies to handle the laborious task of categorizing the generated learning materials, gathering learner preferences, and applying this data to identify the best learning materials for each learner. The four phases of the suggested structure are delivery, feedback, characterization, and authoring. Building learning objects using a common learning object model to facilitate sharing and reuse is done at the authoring stage using a learning content authoring module. During the characterization phase, each learning module is described based on its content and applicability to particular learning styles using meta-data that is added using the tagging module and taken from the subject matter and learning domain ontologies.

3 Conclusion and Future Work.

The development of a completely customized e-learning system has been drawn out by this research. Though they have been present for a while, the technologies have not been integrated in a way that meets the adaptive goal. Subsequent investigations in this field will encompass the following:

1. Establishment of a tool for writing learning objects that supports the sharing and reuse of learning objects, based on the framework of the IEEE 1484.12.1-2002 standard.
2. Establishment of a system for characterizing learning objects that makes use of the relevant ontology to describe learning objects and store them in searchable repositories.
3. Plug in an adaptive model to act as an agent to attend to the learner's preferences and search online learning object repositories for appropriate ones for the learner.

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