1. INTRODUCTION

1.1 GENERAL INTRODUCTION

The 21st century in developing countries witnessed a growth of learners and educational setups that are continuously moving towards modern technology which is becoming persistent within a diverse form of learning environment. The range of these scientific platforms is from the tools that support auxiliary learning to the classroom activity. These advancements are full of learning techniques which refers to a collection of technologies supporting a new form of teaching and learning known as e-learning. All across the world the educational sector from the past two decades has shown an ever increasing assimilation of communication and learning technologies [1]. The education sector nowadays is altogether a different story due to technology transformation. The internet plays a critical role in a way the information access is provided to the users across the countries without any hitch which was impractical before. Thus, the facet of education is being renovated each day by which a variety of innovations are provided due to technological evolution. Currently, many varieties of the finest technologies are available for education, but the basic task is to get more concerned about the optimum use of these technical resources to make learning at higher education very effective.

The internet is being labelled as the primary aid playing a big role in transforming the community as it has continuous penetration and widespread usage in all walks of life. The development of internet-technology and the variety of uses made its inclusion an inexpensive a feasible option for education. The educational institutes of developing countries are facing numerous challenges ranging from the deficient in infrastructure, lack of skilful human resource, insufficient finance and the lack of clear vision [2]. A general certainty among society is that modern learning technology can transform the old age concept of teaching and learning by making it attractive, exited and more relevant with respect to the learners. So, the inclusion of communication technology will drastically make changes to the quality of education and learner experience [3]
E-learning systems are certainly an expansion for uplifting higher education to entirely different heights. E-learning is being used inefficiently in institutions of developing countries, while it is extensively being incorporated in business sectors with the help of the Learning Management System (LMS). There are some institutions where e-learning setup has been established to connect the learners outside the boundaries of the conventional classroom system, and it has retained a positive sign or effect among the learners. The previous research has shown the e-learning effectiveness on the higher educational environment worldwide [4]. The primary objective of e-learning is to provide a system where the faculty finds it easy and convenient to handle the learning material or resource as per progress and requirement of a learner is concerned. The Educational Data Mining (EDM), which is a mechanism in the modern learning system that compiles the learner data consistently to keep a check on learners' development and performance. Unfortunately, a vast number of e-learning approaches were unsuccessful to come out with a normal evaluation of the learner's development based on the data retrieved.

Today a learner should have all the modern educational facility since they are growing in a knowledge base society. Considering various challenges and other affairs to introduce e-learning, it is of critical significance for the researchers to play a significant role in framing future learning practices; some of them are as follows.

- Eliminating the barriers to learning participation and preparing the people for better employment.
- By elevating the standard of educational to improve the up-skills and quality at working place and overcome obstacles of place, pace, and time.
- By making use of learners potential for achieving the goal.
- Utilizing broader participation of learners to remove the barrier of distance.
- To support the physically disabled learners.

The overall e-learning system is versatile or multifaceted nature which covers a wide variety of methods and techniques to open the access to ever increasing educational population [5]. In e-learning systems the pliability of place,
pace, time, and personal learning environment is the main reason behind its popularity and success in developed countries. E-learning has become an important policy for most of the top institutes in developing countries as well which finds it suitable for better and fast information delivery [6].

E-learning is a future tool that will counter the challenges of an educational system in developing countries. E-learning allows having a glance at conventional approaches of learning and also opening the latest educational opportunities. It is being viewed as the need of the hour that knowledge and Information based societies absolutely must be have contemporary means of education system. To understand the issues and challenges with the introduction of e-learning is of vital importance for researchers concerned with e-learning as it have a significant role to frame future practices of learning [7]. In the present age of unique information and communication growth, the existing procedure of conventional system of education is disappearing into oblivion. For present educational system e-learning has become the backbone and the learners for pursuing knowledge which perpetually resort to the employment of technology to obtain high-quality information, notes, appraisals and communicate when needed.

In e-learning, communication technologies are characterized into two types, one is Synchronous, and another is Asynchronous technologies. The synchronous mode is to exchange data and concepts with one or multiple parts concurrently. An interface discussion and chat or Skype session are the examples of synchronous communication. The asynchronous activities are more stimulating which include Forums, Wiki, and Blogs of dynamic debate. The primary motive is that participants should be capable of exchanging data, concepts, information without worrying about the presence of other concurrent participants. The e-mail is an asynchronous mode, in which the sender or receiver does not need to participate instantaneously [8]. The benefit of learning in asynchronous mode is that it facilitates the learner to study as per the capacity, interest, inclination, and convenience. All asynchronous characteristics of learning were emerged as an additional benefit to the learner who is sick and is unable to attend the classes. Learners are empowered with the essential skills to effectively cover up assignment in a comfortable set-up and at an adaptable time-frame. The
asynchronous mode of e-learning is exclusively meant for the content management mechanism where the learners have an option of browsing the data for some occasions devoid of concurrent teamwork. E-learning is concerned with the implementation of a computer based system of education without the constraints of time and space and provides a flexible environment for education.

E-learning has added a new level to the teaching and learning process from within as well as outside the classroom and still searching the opportunity to become more helpful with the use of modern learning management systems and supplementary technology tools. In developing nations e-learning is playing an important role for improving higher educational system, thereby performing a vital role in contributing towards sustainable development and knowledge economy of the country. Nowadays, in teaching and learning process the e-learning represents the employment of information technology, like other computer-aided mechanisms, the Internet, and mobile system, around all significant parts of the world. In this regard setting up e-learning in Institutions deserves to employ and guarantee that the system will be placed appropriately and after that sustain effectively [9].

It is disheartening to see that educational institutions commits a grave mistake by adopting and setting up e-learning mechanism without proper consultation of faculty and deep research to check different features which can impact on the acceptance of the system within a given framework. Mostly, Institutes turn a blind eye to strategic modules required in their strategic implementation and the fundamental backbones of e-learning (Pedagogical, Technological, and Managerial). Subsequently, these institutes land up in outsourcing it or do not reach anywhere, and invariably the system will be ineffective and ultimately detached from the mechanism. The requirements of a learner at the present time have grown up along with their different needs from e-learning based systems. It is imperative to take into consideration different constraints such as technological and pedagogical features, growth, success and the proper execution of e-learning. Hence, there is a need for some strategically essential steps to promote and implement e-learning, and it is high time to put in place some appropriate models that not only mitigate the weaknesses in the
current e-learning system but also help in increasing chances of e-learning acceptance among students and faculty.

The requirements of the university students have gone up, with their varied needs and ever mounting aspirations for the e-learning based courses and the same conditions hold true with the functioning of e-learning institutions proficiently. The rudiments of acceptance and utilization of the e-learning have to be revealed to promote the advancement of the system. It is highly essential to concurrently take into consideration several constraints such as adoption, workload, and motivational parameters, for the proper execution of the e-learning. Nevertheless, the deficiency of the of theoretical or conceptual structures for the effective implementation of e-learning systems has paved the way for different outcomes, leaving a fundamental question unanswered; What are the essential features that have a positive effect on the efficient delivery of the e-learning [10]. For e-learning to be genuinely useful, it has to provide learner-centric facilities. The success and the failure of any e-learning system depend on their performance and how well they are in retrieving relevant information according to the requirement of a particular learner.

The ubiquitous development of web-based technology is to become trendy with the objective of providing diverse types of information as per learner requirement. To provide a better experience to the users as far as e-learning services are concerned, a variety of novel methodologies and techniques are evolved with the aim of reducing the user effort. All these prevailing conditions are creating the opportunities for Recommender System (RS) to grab and it has been seen as the most important use cases on the web. RS’s tried to help learners’ in stirring information retrieving from the available data and match it with learner preferences. During the past two decades, Recommender System has collected huge support and consideration from users and it has become more or less ubiquitous in nature as the information overload escalates with the expansion of new technologies [11].

Basically the Recommender System is a division or a sub-set for the concept of information filtering that showed huge potential of assisting the users
for creating the individual learning environment by recognising the most suitable item from a large repository and then suggests them to the learners on the basis of interests, ratings and the preferences of other similar learners. The fundamental process of recommendation is shown in figure-1.1

![Diagram of General Recommendations / Personalization Process](image)

**Figure 1.1 General Recommendations / Personalization Process**

The Recommender System is nowadays the most significant and extensive tool used whose presence has been noticed nearly in all application software’s for abundant information filtering to support personalization for providing the vital relevant information which is most likely in the interest of its users. The recommendation systems have performed well in most of the popular domains like social and entertainment media, movies, news, books and largely in e-commerce [12]. The recommender systems present more relevant recommendations for personalization utilizing information related to interests, learning object context, tasks and even location. The core of all recommendation systems is searching techniques based on algorithms, similarity measures and also techniques from data mining (DM) [13]. Basically, the conclusion of previous study is encouraging researchers to develop recommendation systems which provide significant and interesting courses to the learners. During conventional studies, the learner will enquire about the course suggestions to its seniors, colleagues and even faculty members. Even after receiving information from all these sources still findings are not comprehensive and this is main reason researchers are trying to mechanize the process of searching the appropriate courses to benefit learners' by using the methodology of recommendation.
The recommendation system provides support to the learners for finding an item of their interest and such systems can be used in all domains whose aim is not just the e-commerce. The area of e-learning in education is considered as the most significant area where the focus of recommendation approach would not only increase the efficiency of learners’ but also improve education standard. This is sufficient reason for the stakeholders who are eager to invest in scholarly research for enhancing teaching learning practices. Generally, the methods in EDM are divided into various categories and can be served for different purpose. Some of the utilizations are Prediction, Data retrieval and Clustering, Relationship Mining (RM). The methods in EDM are also divided into various user groups as per the needs like Faculty, Learners’ and Administrators. For a learner the primary requirement is to fetch relevant resource information that would enhance the knowledge. The assignment of suitable courses along with track on study is a critical issue need to overcome for a successful academic life [14].

To produce the relevant course recommendations for the learners, this research work has used the basic techniques of EDM and information retrieval algorithms as there are educational system and other domains are having few similarities. First, the options related to item quality have little distinctive characteristics and secondly, there are huge numbers of choices available in items to choose, but the aspect of choosing a course is varying completely from choosing a movie or an item to buy. Third, almost all of the e-learning systems have coupled some common issues and one of the issues is the time a learner has to spend to find appropriate objects, courses and even content as per the requirement. As a result, Recommendation systems, which are simply software agents, were developed to control this issue of information overload by intelligently recommending the resources to the learners’.

In e-learning systems, the learner has choices to select courses among hundreds of courses every time. Such scenario of having many choices is perhaps an excellent thing, but it’s hard for learners’ to go through the courses and the information associated with it. Even if counsellors would be employed by institutes for guiding and helping the learner to make their choice, but in reality, it is not possible that every institute will afford the counsellors. Even if institutes do
provide such facilities, the counsellors will not be having enough time and may get learner or student overload. In most of the cases, learners are dissatisfied with the knowledge level possessed by those counsellors.

Recommendation of courses and other learning resources concerning personalization is being considered as extremely important, because current learning demand is for personalization to be more proficient and valuable. Personalization refers to the experiences, selection of learning approaches, and the category of strategy that will address a variety of learning interests, backgrounds, requests and aspirations of individual learners’ [15]. This is true, in particular with almost all learners and especially in situations in which a learner is entering the learning system with different experiences and background. In existing scenario the basic problem that learner encountered is that they are not able to point out exactly the courses which are important for them from study view point. Since, it is imperative for a learner to acquire skills and knowledge that will help them to do research more effectively and efficiently. Due to the accessibility to a wide variety of course options available can put learners’ in a rough situation for deciding about the more suitable courses for them. The one-size-fits-all model is another critical problem with the current learning system. To add a personalization feature in such systems will be a stepping stone towards progress and that will be more customized and provide interactive provision of learning courses. Such sort of recommender feature will support learning by tailoring the requirements of a particular learner as per the needs and area of interest.

The personalization is to tailor individual learner needs based on their interests. Personalization has earned appreciation and noteworthy interest in the form of recommendations as people in daily life believe and seek peer recommendations for decision making. [16]. Recommender Systems have been adopted in a variety of fields like social networks, YouTube, e-health, and e-commerce sites, While reflecting the social behaviour of supporting users in taking a decision for making an effortless and a wise choice. [17]. Personalization using recommendation approach represents a transformation and a big leap from the default approach of one-size-fits-all of e-learning system towards a tailored stipulation to choose courses for learning. By personalizing the needs of a learner
which is based on the learners’ area of interest, preferences, knowledge and other requirements would maximize the learning experience.

Personalization will support the process of learning by tailoring individual learner needs. However, providing personalization requires preliminary groundwork of developing a knowledge model for available courses as per domains and sub-domains which is an arduous chore and have to be done with the help of ontology editing tool. Ontologies form the basic ingredients for semantics and utilizing the ontology in the form of vocabulary controller will help in recommending courses which are related together. To guide the process of knowledge modelling, the criteria for model development must be known.

The recommendation in e-learning systems should be based on:

- Basic needs of the Learners’
- Background knowledge of Learners’
- Semantic concepts are woven into the system
- The required conceptual knowledge for creating the knowledge model

Enhancement of learning quality is the requirement of the century and the novel pattern that will attract learners’ and faculty towards e-learning systems is the feature of personalization. Personalization is considered useful for improving the learning experience and research quality by recommending courses which are otherwise overlooked or skipped by them. To find the best possible match, the learners’ going through the curriculum to find the course of choice is a protracted task and for the same reason the course personalization will provide an answer to the problem which one size fit for all doesn’t offer.

The personalization process involves recommending the learner with the courses of interest and requirements of their concern, which not only covers the individual learning needs and background, but also cover achieved improvements in learning course, awareness and other requisites. The course personalization is usually realized by means of the learner’s choice, query or by learner’s profile. The learner is offered with the relevant data which suit their prerequisites. The
personalization in the traditional learning environment has to meet the requirements of a large majority of the potential learners invariably, whereas, in the case of the e-learning, it can be personalized by the specific requirements of the learners concerned, which always prefer learning objects as per their whims and fancies. Equipped with the added functionalities within the project, the ontology continues to be in the supportive position as the link between the courses and the distinct interests of the learners.

The demand from future e-learning system is providing the information which is based latest information retrieval concepts with associated semantic and high accuracy in terms of precision and recall factor than traditional keyword based searching. Semantic technology uses the concept of ontologies to represent the collective conceptualization of a domain. Various researchers are using the ontology for different aspects of e-learning like personalization, learner modelling, and adaptive hypermedia educational systems. If Ontology is developed for the purpose of education, it will be a step forward towards the conception of shared and reusable knowledge model for a unified system [18-19].

To share and reuse the knowledge across different systems the ontology is efficiently used by various researchers and application developers. The primary intention of ontology development is to define the terminology which is universal for sharing and reusing domain information. It also includes machine interpretable definitions of indispensable concepts of a domain along with the relationships between the concepts. By developing the common ontology and then reusing and share the same across dissimilar systems could be easily achieved with any kind of environments and its prospective of contributing for an educational environment is massive. The basic ingredients for semantic web is to personalize current learning system is provide by Ontology [20].

To define the concepts, classes, objects, and creating relationships is the most complicated step of creating ontology which are used by the people, databases, and by the applications to share domain information. Ontology is extensively used for information extraction, information retrieval, information science, knowledge modelling and its description can prove useful in information
gathering with apparent meaning that will directly made the implied property and knowledge explicit. The ontology would be able to cater the learner need in terms of learning context with some distinct relationships [21]. The e-learning is basically systems where one can study or learn over the web and a learner can choose their courses online as well. In such modern learning systems, the learners are not catered with the courses of interest which proves that one size does not fit for all. Thus, the solution to make this e-learning system to cater the learner needs is hidden inside the concept of recommendation. The aim of recommender system is to offer the recommendation facilities which allow the learner to receive the learning resource automatically and as per the domain of interest and also create ontology related to learners.

This study focuses on providing a facility to the learners to personalize the courses as per their individual interests by generating appropriate courses from various domains for all different learners for maximizing the learner process. The learner domain would determine the suitability of the courses and with the help of course relationship in the ontology related courses are also fetched for the recommendation. In ontology classes and sub-classes within the domain are defined with a predefined number of courses in a specific domain. The coloured block concepts as shown in Figure 1.2 are used to built the hybrid technique in such a way that the learner would get more appropriate choices to choose courses. The whole recommendation process is based on the course relevancy assessment and domain of a learner

Various approaches were attempted to introduce personalization feature in e-learning systems because e-learning system has not been completely personalized. The current system of e-learning will deliver the similar content or learning resources to all the learners even if the learners possess different profile and background and no system has been modernized with recommendation approach to deliver the courses. A number of e-learning systems mostly rely on the explicit information provided by the learner and by using different techniques are providing the presentation and navigation facilities into the system.
1.2 MOTIVATION

There are certain factors that are already known to play a deciding role in the process of course selection for higher educational study. But in actuality, various other factors are probably having a significant role in choosing the course aside from the help of faculty and learner himself. From the perspective of being a researcher and the anecdotic confirmation from other scholars as well, the most important among all the factors are as follows

**Learner interests:** The courses a learner choose may cover the matter that learners are interested and want to know more about the subject, because the learners are very careful about the personal and professional interest nowadays.
**Career Aim:** The choice a learner is having while choosing the course should cover a domain to learn that leads to a career after completing the studies. Nowadays learners are future conscious as far as higher studies are concerned.

**Course requirement:** Sometimes a learner wishes to register in institutes where there are certain prerequisites before getting registered such as the number of courses for completing the degree or some kind of certification.

**Format of course:** Another factor influencing course selection is concerned with course credits, classes required, and the organizational feature of the course.

**Level of difficulty:** At times learners commit a grave mistake by choosing simple courses without knowing its effect on their performance because they find it easy to complete the credits. Instead a learner should select the courses based on its significance and the knowledge gained by the course.

**Social significance:** Some learners prefer to be social and would favour to select the courses which match with the domain of their colleague in order to get some timely information, idea, and even help at times they need.

**Course timetable:** There are situations which may arise such as course timing mismatches with the learner schedule and make the task of selecting the courses very challenging.

In order to view the entire available courses in the domain of Computer Science (CS) could be a challenging task, since more than three hundred courses are under the CS domain. Thus organizational or institutional sites can provide the information in the form of diminutive explanations related to syllabus and the courses in it. They also provide information related to various programs, core and optional courses available along with aim and conclusion. Learners who want to know more about the programs and the available courses continuously has to search the information that fascinates them. After consuming enough time to find the courses of interests, the learners either will call upon the peer learner who already had been through the courses or might use the prior knowledge or may
contact a subject matter proficient for choosing the appropriate courses. This method of courses selection in which a learner has to find sail across to find its potential course of interest is prolonged, inflexible and brainstorming and overall difficult for a learner. Further, the institutional websites or the e-learning systems cannot help a learner in course filtering, since there are no such options available with their system.

All the above mentioned things gave motivation to build up a hybrid RS which not only facilitate the learner to personalize the courses as per the interest for improving the performance but also eliminate the hard work they go through while selecting the courses. Second reason that motivated was to enhance capability of e-learning system with RS approach and incorporating the feature of personalization in it. Third reason that motivated to do the research was to initiate the development of CS knowledge model by framing the courses ontology.

The aim of proposed research work is to build a recommender generation technique for improving the efficacy and the performance of current e-learning structure. The present thesis will focus on providing the course personalization feature to learners for carrying out their learning activity in an effective, efficient and intelligent manner. Moreover, the research study is evaluating the proposed recommendation framework using an experimental sequence with Technology Acceptance Model (TAM) to identify the learner’s reaction towards the acceptance of the proposed RS. The study shows that effectiveness of e-learning systems and that of software support can be improvised to be more efficient by enhancing their functionality.

1.3 OBJECTIVES AND SCOPE

The primary objective of the research work is focused on to develop a hybrid recommendation technique to mitigate the issue of course personalization in e-learning system and to generate similar learners using Threshold Based Nearest Neighbourhood approach (TBNN) to improve upon similar learner detection in nominal time. Further, it is proposed in this research work that RS use ontology as the basic component. The RS system could be incorporated with
e-learning system to improve its effectiveness by improving the functionality that will be helpful to streamline the course selection process and provide a lifelong ontology for all domains. The system will facilitate effective workflow management and will Increases functional efficiency of e-learning systems by avoiding brainstorming session for learners and faculty. As a result it will increase the confidence level among learners for recommendation based decision making and thus reduce the number of those learners who ended up with the regret on their judgement.

Some of the specific objectives of the research work are to propose

- The methodology for building the ontology from scratch in the domain of computer science by gathering and utilizing the experience of the faculty members.

- An algorithm to enhance the keyword based information retrieval technique used in traditional recommender systems.

- Threshold-based Nearest Neighborhood Algorithm (TBNN) to improve upon K-Nearest Neighborhood for generating similar learners for the new targeted learner with the same characters and the characteristics among its neighbors.

- The modified Technology Acceptance Model (TAM) for providing experimental outcomes and to reveal the feasibility and effectiveness of the proposed system.

1.4 RESEARCH CONTRIBUTIONS

This research work will be beneficial for the new researchers, faculty and the entire educational committee in general and brings some contributions in the following effective way of enhancing the e-learning system.

- A transparent and clearly defined architectural methodology is proposed to
develop an ontology that is more effective in information extraction from text descriptions as compared to simple data storage.

- This work offers new insight for basic algorithms to find new application areas of e-learning for providing content personalization.

- A new sem-gram algorithm based on n-gram technique has been identified. The algorithm is relevant for query expansion and classification of the query into a listing of N categories. The primary work has been committed to this algorithm for generating course recommendations.

- This Research work proposed a framework that Integrates Semantic, information retrieval and supervised learning methods.

- The proposed hybrid technique overall provides a higher accuracy degree as compared to the individual techniques and is exposed to different domains.

- The Sem-gram approach act as a baseline along with ontology and similar learner generation to provide better results as evidenced by the evaluation.

- The proposed system can be incorporated with e-learning system to streamlines the course selection process, and also Learners can be analyzed graphically with the help of personalized learner ontology.

To evaluate the Recommender System, two types of testing were done. One is the metrics approach in which precision and recall method is calculated using confusion metrics. Another evaluation is done by using Technology Acceptance Model, which is unique model of acceptance in a way that it tests internal as well as external constructs for intended user behaviour.
1.5 THESIS OUTLINE

The remaining part of the thesis work is arranged as follows

**Chapter 2 Literature Review:** It gives a comprehensive review and unveils the earlier works completed in Recommender Systems that are related to the proposed work. The detailed work on recommender strategies in e-learning is also discussed. The chapter also includes a comparative study of existing recommendation techniques and the newly adopted ones.

**Chapter 3 Ontology Development:** It provides an ontology model that will be handy for a learner to get an overview of a theoretical domain which otherwise is very hard to comprehend. The architectural methodology for developing ontology in the domain of computer science is discussed in this chapter.

**Chapter 4 Recommender System Architecture:** Chapter 4 describes the proposed Sem-gram technique combined with ontology and the implementation of a supervised learning technique for recommendations. The whole working of the system is discussed and the experimental design is revealed. Comparison among techniques is described with some experiments for arithmetical approach.

**Chapter 5 Result Analysis and Discussions:** This chapter 5 will do the analyses and discussions for the overall performance of the proposed system.

**Chapter 6 Modified Technology Acceptance Model (TAM):** It explains the TAM and the related hypothesis are derived with respect to dissimilar constructs which are affecting user acceptance of technology. Few external variables were introduced in the model and their consequences on the dependent variables are discussed.

**Chapter 7 Conclusion and Future Scope of the Research Work:** The summary of the proposed recommendation technique and the future work need to be carried out are concluded in this chapter.