DEVELOPMENT OF FRAMEWORK FOR INNOVATIVE e-LEARNING USING ACTIVITY THEORY AND WEB 3.0

By

NAMRATA DHANDA

COLLEGE OF ENGINEERING STUDIES

Submitted

IN PARTIAL FULFILLMENT OF THE REQUIREMENT OF THE DEGREE OF DOCTOR OF PHILOSOPHY

TO

UNIVERSITY OF PETROLEUM AND ENERGY STUDIES

DEHRADUN

September, 2014

ACKNOWLEDGEMENT

First of all I would like to dedicate my work to my mother **Late. Smt. Saroj Bala** for being with me all the time with her blessings. It is due to her divine trust in my abilities which empowered me to go ahead with this work.

I am highly indebted to my Internal Guide **Dr. Neelu Jyoti Ahuja** who has guided me all through the completion of this PhD thesis. My enthusiasm in this subject is inspired by her profound knowledge in this area and her elegant research style. She has helped me with her wise advise, useful discussions, comments and facilities.

I am very grateful to my External Guide **Prof. (Dr.) Manuj Darbari**. His incessant enthusiasm, support, knowledge and inspiration have given a new dimension to my work. Without his sustained and sincere efforts, this thesis would not have taken this shape.

I would also like to thank my External Guide **Dr. Imran Ali Siddiqui** for helping me throughout the research process and helping me overcome the various difficulties and challenges that were raised at various stages of the project.

I would also like to pledge my deep sense of gratitude to **Prof. (Dr.) Parag Diwan**, Vice Chancellor, University of Petroleum and Energy Studies (U.P.E.S), Dehradun for extending all the facilities required for carrying out this thesis work.

I am thankful to **Prof. (Dr.) Shrihari**, Campus Director, U.P.E.S, for his guidance related to research norms of the Institute at all stages.

I wish to express my deepest sense of gratitude to **Prof. (Dr.) Kamal Bansal,** Dean, College of Engineering Studies, UPES for his kind co-operation and motivation during my research work.

I would also like to give special thanks to **Prof. (Dr.) Manish Prateek**, Head Center of Information Technology for providing me guidance during crucial times.

I am thankful to **Mr. Mahesh Agarwal**, Managing Director, Goel Group of Institutions, Lucknow for his kind support and encouragement in promoting research activities in the Campus.

I would also like to thank **Siddharth Lavania**, Assistant Professor, Department of Computer Science, Goel Institute of Technology and Management, Lucknow for his continuous support during my research work.

My sincere thanks to my brother-in-law **Mr. Vikrant Sharma** for his valuable suggestions and motivation.

I wish to thank all my colleagues in the Department of Computer Science/ Information Technology for their helpful suggestions.

The vitality of this work was enhanced by the support I got from my family and friends. Last but not the least I would show my gratitude to my father **Mr. Harish Kumar** and my sisters **Mudrika Dhanda and Bhavna Sharma** for their kind support and motivation throughout my research work.

Namrata Dhanda

DECLARATION

I hereby declare that this submission is my own work and that, to the best of my knowledge and belief, it contains no material previously published or written by another person nor material which has been accepted for the award of any other degree or diploma of the university or other institute of higher learning, except where due acknowledgment has been made in the text.

Namrata Dhanda

Date:

THESIS COMPLETION CERTIFICATE

This is to certify that the thesis entitled "**Development of Framework for Innovative e-Learning Using Activity Theory and Web 3.0**" submitted by **Namrata Dhanda** to **University of Petroleum and Energy Studies** for the award of the degree of Doctor of Philosophy (Engineering) is a bonafide record of the research work carried out by her under my supervision and guidance. The content of the thesis, in full or parts have not been submitted to any other Institute or University for the award of any other degree or diploma.

(Dr. Neelu Jyoti Ahuja)
Internal Guide

(Dr. Imran Ali Siddiqui)
External Guide

(Prof. (Dr.) Manuj Darbari)
Co-Guide

Place:

Date:

CONTENTS

List of Figures

List of Tables

List of Publications

[1] Dhanda, N., Darbari, M., & Ahuja, N. J. (2012). Development of Multi Agent Activity Theory e-Learning (MATe-L) Framework Focusing on Indian Scenario. International Review on Computers & Software, 7(4).

[2] Dhanda, N., Darbari, M., Ahuja, N. J., & Siddiqui, I. A. A Critical Review on E-Learning Prospective: With Special Reference to Migration from Web 2.0 to Web 3.0.

[3] Dhanda, N., Darbari, M., Ahuja, N. J., & Siddiqui, I. A. An Adaptive Normative Multi-Agent System Using Web 3.0 for E-Learning Platform.

EXECUTIVE SUMMARY

In order to facilitate a better educational experience to the students it is essential to build up systems which are capable of offering specific and personalized contents to the students in an intelligent way, i.e., the systems are capable enough of making decisions about which is the most suitable educational content at any instant for each learner enrolled in the system.

A large number of e-Learning methodologies have been developed so far, but there is lack of interactiveness in almost all the models i.e., the systems are incapable of intelligently recommending the most appropriate course content to the user based on his educational records and feedbacks in real time.

The emergence of Information and Communications Technology (ICT) has led to the evolution of new learning and training methods in recent years. e-Learning is one of the foremost strategies that makes use of ICT with traditional elements of learning. There are various social and technological advances that have led to a rapid change in the field of higher education. The emergence of new ideas and visions in the field of education has replaced the traditional teaching by e-Learning in the different higher education institutions. Novel methods of teaching are in existence to support complex learning and developing professional skills among learners.

The work described herein not only concentrates on the learner modeling part but

it also contributes in the establishment of an adaptive environment for learning by compiling the different approaches that the learner uses for resolving problems. The current work proposes a framework to overcome the existing problems of e-Learning using Activity Theory and Multi Agent Systems. The motive of this thesis is to make the existing e-Learning systems more users specific by using the concept of Web 3.0 because of its ability to work in single user mode and community based mode. The framework is then verified using Hypothesis Testing.

The work is summarized in the following steps:

Step 1- The study of e-Learning Systems and the various concepts like Activity Theory, Multi Agent System and Semantic Web that will be used in the development of e-Learning framework.

In this step, we summarize the concept of e-Learning systems, and why it has replaced the traditional learning system in higher level education. The components and characteristics of the e-Learning systems have been described herein. Some of the major drawbacks of the existing systems like lack of interactivity, time boundedness and content not being updated on frequent time intervals have been revealed and further work has been carried out in the following chapters to overcome some of the deficiencies of the existing systems.

Due to new trends in the development of educational systems and the need to develop applications that can be accessed remotely, and hence managing the security of e-Learning systems and its access control is a major problem that has attracted the attention of researchers and web application developers. Therefore, meeting the security requirements in an e-Learning system is an extremely

complex problem, because it is necessary to protect the content, services and personal data not only from the external users, but also from the internal users, including the system administrators. For many students, it is not always possible to attend regular classes due to lack of time and money at the same time, but they can afford to save time and money for self study due to which they prefer e-Learning systems.

Step – 2 Development of a tool MATe-L using Activity Theory and Multi Agent Systems for e-Learning

Activity Theory is a philosophical and cross disciplinary framework for studying the different forms of human practices as development processes, with both individual and social levels interlinked at the same time. The entire learning activity should be the main unit should encompass all the human aspects, social interactions and the production rules that will govern the activity of interest. Activity Theory is best suitable for such kind of data abstractions. It considers each learning situation as an activity that is designed to accomplish a certain goal such as acquisition of knowledge by a learner or transmission of knowledge by a tutor. It is commonly used within Enterprise Modeling community although it is not a fully developed theory but a framework from which several ideas, theories and methods for conceptualizing human practices (activity) in relation to computers could emerge.

Apart from Activity Theory, we have used the concept of Multi Agent Systems. The aim of the e-Learning agents is to increase the content distribution of the existing courses by delivering the right course information to the right student. We

have developed a tool MATe-L which could manage all the e-Learning activities. The concept is realized using AUML. The tool MATe-L supports all the functionalities and relationships of Activity Theory and e-Learning in Agent UML. The basic diagram of Object Oriented AT framework developed by is extended for this purpose in an extension of UML known as Agent UML (AUML) is used to synthesize an evolving concern for agent based modeling representations. The main advantage of developing such a tool is the type of Message Delivery. Agent UML represents Nested and Interleaved Protocols. Message interactions are communicated asynchronously. It represents the yielding of the thread of control i.e. agent role waits until an answer message is received and till then nothing else can be processed. The other option is Agent Class Diagram which currently meets the FiPA Norms. We have proposed two algorithms. The first one is for allocating the right course to the right student based on his/her preferences and existing knowledge. The second algorithm is for learning that is whether the student has learnt the allocated course.

Step-3 Application of NORMS and Semantic Web in e-Learning

In order to design a good e-Learning framework, the focus should not entirely be upon the educational content that is designed for a particular course or upon the ways by which human computer interactions will take place. The semantic web is an idea of information that can be eagerly interpreted by machines, so that machines can execute more of the tedious jobs involved in locating, integrating, and acting upon the information on web. Semantic web, as initially envisioned, is a system that facilitates machines to "recognize" and react to complex requests by

humans based on their sense. This kind of "understanding" requires that the related information sources be semantically ordered. The concept of Norms is used in conjunction with Semantic Web. Web 3.0 gives an atmosphere that can vary from generalized to personalized and from slow speed to fast speed using a 4G support by means of Smart TV sets.

Step-4 Verification of the e-Learning Framework using Hypothesis Testing

In statistical hypothesis testing, we make a statistical inference based on the data that has been gathered from a research or survey carried out. If the occurrence of the result is predicted as unlikely according to the pre-calculated threshold probability also referred to the significance level, then the result is called as statistically significant in statistics. The tests of significance are used to determine that which outcomes of a research will direct to a denial for a pre-specified level of significance of the null hypothesis. We have performed Hypothesis Testing to validate the e-Learning framework that we have developed.

Step-5 Conclusion and Future Scope

The proposed framework has shifted the focus of the learning process from the tutor centered to learner-centered approach. This migration will give the learners a self paced learning process in which they have more opportunity to select their study material and learn according to their own spirit. The main purpose of the framework is to make the e-Learning system which can be personalized as per individual's preferences and requirements so that anyone and everyone can make the best use of it. We can finally summarize our work by developing a framework using web 3.0 for e-Learning. The major component that distinguishes it from

conventional e-Learning is the utilization of Activity Theory (AT) and Normative Multi Agent System (NorMAS). In future, we can extend our work which involves development of NormATe-L language on principles of Deontics.

CHAPTER 1

INTRODUCTION

1.1 PREAMBLE

This thesis discusses, in general terms, the application of Activity Theory, Multi Agent Systems and Semantic Web in designing an intelligent e-Learning System. The objectives of the thesis can be summarized as follows:

- individual as well as group learner modeling,
- modeling and employment of didactic approaches,
- adaptive alertness,
- support for collaboration organization,
- support for generating personal learning histories,
- support for ongoing co-operation / collaboration.

The work described herein not only concentrates on the learner modeling part but it also contributes in the establishment of an adaptive environment for learning by compiling the different approaches that the learner uses for problem solving. The present work proposes a framework to conquer the existing problems of e-Learning using Multi Agent Systems and Activity Theory. The motive of this thesis is to construct the presently existing e-Learning systems more user specific with the use of the concept of Web 3.0 because of its capability to operate in two

isolated modes: the individual / single user mode and community / group based learning. Hypothesis Testing is then used for the verification of this framework.

1.2 NEED FOR PRESENT WORK

There are number of e-Learning methodologies that have been developed so far, but all models lack the interactiveness where the system can intelligently recommend the most appropriate course content to the user based on his educational records and feedbacks in real time.

Even though e-Learning, the novel technology of supporting training and education has recently been gaining a lot of attention, but still it has certain drawbacks which need to be worked upon to make the learning system more effective. Content retrieval in e-Learning refers to the method by which the study material is given to the learner by means of digital or electronic medium. We have developed a successful web-based learning model, in which various agents can be assigned exclusive responsibilities in order to cope-up with the content recovery and content release to a variety of users. The system based on the concept of Multi Agent system can deal with the information that is stored in the e-Learning atmosphere and granting access to various data content. All the tasks are performed by an independent agent and a variety of such agents are gathered to shape a multi-agent based system.

For facilitating a better educational experience it is essential to build up systems which are capable to present customized and specific contents to the learners in an intelligent manner, i.e., the systems able of building decisions about which is the most appropriate educational content at any instant for every learner. The Activity

Theory model's components are associated with Normative Multi- Agent System (NorMAS). Renovation of NORMS to Activity Theory begins by studying a competitive or aggressive component framework.

1.3 SCOPE OF THE PRESENT WORK

The span of the present work is divided into two phases:

1. New framework Norm-AT taking the idea of Normative Multi-Agent System Activity Theory and e-Learning introduced. The fundamental idea of the work is to construct an e-Learning framework that is more user centric. This is achieved by using the theory of Web 3.0, which is able to handle Big Data.
2. Verification of the framework developed in Step 1 by using Hypothesis Testing.

1.4 OBJECTIVE OF THE WORK

The objective of present work is -

- To outline deficiencies in the existing modeling tools and highlight specific areas where these models can be improved upon.
- To develop a framework which is capable of enhancing e-Learning capabilities of students in a real time mode using an integration framework developed using Activity Theory, Web 3.0 and Multi Agent Systems.

1.5 HYPOTHESIS

- Contribution of e-Learning concepts and Activity Theory works better with Multi Agent Systems.

- Combination of Web3.0 with Multi-Agent systems can be better utilized for Web Modeling/ Hypermedia Extension.

1.6 RESEARCH METHODOLOGY

We identify the elements of the model which is based on the interaction of four parameters: Motility, Objective, Assimilation and Constraint. The steps followed are mentioned below:

1. The first step covers the identification of Activity Theory notations and its application in e-Learning.
2. The second step involves the use of concept of Multi Agent Notations for modeling complex e-Learning environment.
3. The third step involves the development a tool MAT-eL which aids in building an e-Learning framework. The utilization of Agent UML aids in software modeling of the e-Learning platform such as Learning Content Management, Computer Supported Collaborative Learning and Learning Management System. The application of Activity Theory improvise the modeling framework since it provides an obvious picture of the psychology of the students that can be modeled into a framework.
4. The fourth step uses a combination of Norm-ATeL by means of the idea of e-Learning, Normative Activity Theory and Multi-Agent system. The fundamental thought of the job is to make e-Learning further user centric by means of the idea of Web 3.0, such as its capability to execute upon two isolated modes: community based

learning as well as single user learning. Our suggested framework is established and then verified through Hypothesis Testing.

5. The last step deals with bringing the thesis to a Conclusion by justifying the work which we have done till date.

1.7 ORGANISATION OF THE THESIS

Chapter 2 gives a brief introduction to e-Learning and its comparison with the traditional learning methodology. It also highlights the various characteristics and components of e-Learning Systems. Lastly, it discusses about some of the deficiencies of the existing e-Learning models due to which the research process is carried out.

Chapter 3 presents literature review of the Unified approach as applied to e-Learning systems. It highlights the work by Keegan [1] classifies distance education in the following three basic categories: Industrialization Theory, Autonomy Theory, and lastly Theories of Communication and Interaction. Shneiderman [2] and Bricken [3] have furthermore point out the capability to bear association between students with the association between professors plus students. It also highlights the works of Ruben and Pavon [4] in the field of Activity Theory and Agent modeling.

Chapter 4 describes the basic introduction to the various concepts and technologies that will be utilized in developing an interactive e-Learning system, which can recommend courses to various students on the basis of their accumulated knowledge. A brief introduction to Activity Theory ,Multi Agent Systems, and Semantic Web has been provided herein.

Chapter 5 is about the effort to develop a model to defeat the problems of e-Learning by the notion of Activity Theory and the Multi Agent Systems. This chapter points out the use of Activity Theory along with the Multi-Agent System for e-Learning. In this chapter, we have developed MATe-L tool which supports in designing a framework for e-Learning. The Agent UML has been used for the software modeling of e-Learning platform.

In **Chapter 6** the concept about Norms is used in conjunction with Activity Theory. The concept is further extended using Web 3.0 to generate the outcome of e-Learning. Web 3.0 gives an atmosphere that can vary from generalized to personalized , from slow speed to fast speed and a 4 G support by means of the Smart TV Sets. We begin this by using OWL e-Learning framework with Web 3.0. It provides an edge above other methodologies by making e-Learning more flexible and adaptive to the learners' requirement.

This chapter discusses these methodologies in concise and later on we shift our focus on combining these methodologies to build Unified Framework.

Chapter 7 presents the verification and validation of the developed framework using the concept of Hypothesis Testing.

Chapter 8 draws the previous chapters to a conclusion and indicates the scope of the Activity Theory with Multi Agent Systems and Norms in the development of e-Learning framework for potential future developments.

It sums up an approach to rectify high-end interaction abstractions into Multi-Agent components forming a refinement process that transforms an abstract learning medium specification into adaptive e-Learning Framework.

CHAPTER 2

OVERVIEW OF e-LEARNING SYSTEMS

2.1 INTRODUCTION

The evolution of Information and Communications Technology also known as ICT has led to new learning and teaching methods in recent years. e-Learning is one of the main strategies using ICT with conventional elements of the learning. Various social and technological development have led to a rapid change in the field of top education. The emergence of new ideas and visions in the field of education has replaced the traditional teaching of the e-Learning in the different higher education institutions. New teaching methods are in place to support complex learning and develop professional skills among learners.

e-Learning is defined as "pedagogy empowered by digital technology [5]." It is the basically the learning material and the learner experiences that are delivered to the students electronically using the various available technologies. Technology here refers primarily to the application of Internet technologies and communication to improve the training and learning process support.

The e-Learning consists a broad categories of various applications and processes, for example education via the Internet / Intranet (web-based learning), instruction by computer systems (computer based learning) virtual classrooms and digital

collaboration. Content is available electronically via the Internet, Intranet, audio or video cassettes, TV, CD-ROM or DVD. Usually, the term e-Learning is understood that online learning (web-based learning) and online courses. If we consider the same aspect, the process of learning assisted by computer could be considered as a component of e-Learning that doesn't require nonstop instructor and other students interaction.

The e-Learning is a form of distance learning, since the students and the trainer may exist in distant locations, plus the interaction is essentially asynchronous in nature. It has replaced the traditional form of time / place / content based pre determined learning with anytime / anywhere customized/ on-demand form of learning. It is a kind of self paced learning methodology in which the learner can study according to its criteria. Table 2.1 below summarizes some of the important differences between traditional learning and e-Learning:

Table 2.1 Difference between Traditional Learning and e-Learning

Parameter	Traditional Learning	e-Learning
Delivery	Tutor determines the agenda	Learner determines the agenda
Access	Has a linear sequence of knowledge that is predefined	Has direct access to knowledge and learning can be done in any sequence convenient to the learner

Responsiveness	It is assumed that the problem is known.	The reaction depends on the problem at hand.
Modality	Learning takes place in dedicated modules with predefined starting and ending points.	Learning process is continuous and runs in parallel to business tasks.
Symmetry	Learning is asymmetric and occurs as a separate activity.	Learning is symmetric and occurs as an integrated activity.
Authority	Centralized i.e., the content is selected by the tutor from the library of materials available.	Distributed i.e., the content comes from the interaction between the learners and the tutors.
Personalisation	It is not personal instead the content must satisfy needs of many.	In this the content is personal i.e., it is delivered to the learner based on his interest and prior knowledge.
Adaptivity	Content usually remains unaltered inspite of the various changes occurring in the environment.	Content is dynamic and is regularly updated.

Since because of new trends in the development of the learning systems and the need to develop applications which can be accessed distantly, and hence managing the safety measures of e -learning systems and its control of access is a major problem that has attracted the attention of analysts and the web application developers . Therefore, mapping the security necessities in the system of an e-Learning environment is an extremely complex problem, since it is mandatory to shield the content, services and personal data from the external as well as internal users and the system administrators. For many students, it is not always possible to attend regular classes due to lack of time and funds at the same time , but they can afford to save time and funds for self learning due to which they prefer e-Learning systems. There are various factors that can influence flourishing self - learning:

- **Motivation of Learner:** These factors embrace financial rewards, satisfaction of job, feedback, praise and success in examinations.
- **Time:** The learner can learn at their own interest and there is not much pressure to attend regular classes. He can learn according to his own comfort.
- **Learner Support:** As indicated above, learning is a social action and a learning community be formed. There is a close link between learners of the same interest. They can interact with each other through various debates and discussions organized by the instructor at different time intervals.
- **Affordability:** Cost of self-study is small and therefore it attracts students from all sorts of backgrounds.

- **Content:** Learning materials must be complete and easy to use and understandable.

2.2 CHARACTERISTICS OF e-LEARNING SYTEMS:

Some of the prominent characteristics of e-Learning systems are described as follows:

- Learning materials together in the form of text, images, and links to other resources present online, audio and video contents are available on the Internet enabling the concept of anytime / anywhere learning.
- Instructor coordinates the virtual classroom. He is responsible for planning the activities of students, organizing discussions to solve various problems in progress, etc.
- The Learning has now becomes a social activity; the learning community is formed by the communication and collaboration amid the instructor and students.
- Some of the e-Learning mechanisms also permit the monitoring of various activities undertaken by a student, while several others are simulations namely; work on subgroups, video and audio interactions [6].
- Learning becomes 24/7 activity as learning can be done anytime and anywhere where there is availability of Web. Thus, the learning process becomes ubiquitous.
- Same learning content is available to all the users irrespective of the location of the user.

- e-Learning is the most profitable to provide guidance or information medium. It reduces travel costs, reduces teaching time and the need for an infrastructure for classroom.

2.3 THE e-LEARNING SYSTEM COMPONENTS

Functionally, forming an e-Learning system involves several components. An e-Learning platform may be categorized into three sections. These sections are Learning Management System, Learning Content Management System, and Computer Supported Collaborative Learning. The description of each of these components is as follows:

2.3.1 LEARNING MANAGEMENT SYSTEM (LMS)

It is primarily used to organize the study actions of a student plus determine the potential of the students that includes activities during study conducted by trainers, education reflection and web-based education. The Learning Management System is principally concerned with the assessment of students' potential, management of study activities and support to the content delivery activities. We can say in other words say that a Learning Management System (LMS) is Web enabled software which caters the release of the content and helps in tracing the e-Learning process across an institution. It helps in the management of administrative tasks by automating the entire process of e-Learning. Also, it maintains a record of the competencies of the learner and their achievements. It acts as a warehouse for storing the learning materials and makes them available anytime and anywhere.

2.3.2 LEARNING CONTENT MANAGEMENT SYSTEMS (LCMS)

It is primarily concerned with the creation, use, location, delivery and content management. Certain conditions concerning knowledge exchange activities are expanded around the subject of the study by capturing unstructured knowledge, and saving the contents in an appropriate method. The complexity of the learning material varies from isolated elements to large co-related learning modules. A group of digital learning materials that is structured in a manner so as to solve the purpose of learning is referred to as a digital learning object. The contents of the learning objects are reorganized several times so as to form a syntactically and semantically correct course structure for a particular learning objective. They are then converted in the form of chapters, modules, course material to satisfy the essentials of a curriculum. These are further used by the content developers who make sure that the requisite content is provided to the relevant student. The functions of the content developers include storage of the content, its administration like cataloging and indexing that provides fast retrieval of data to the learners. Content delivery can be done in two modes:

- **Synchronous Delivery:** In this mode, information is provided to all the learners simultaneously, and hence several learners can communicate with each other and also with the instructor directly. It is the real time mode of learning. Examples of synchronous delivery include Internet Chat Forums, Instant Messaging and Teleconferencing that can be audio, video or both.
- **Asynchronous Delivery:** In this mode of content delivery the information is neither transmitted nor received simultaneously. The learner can learn at

his own pace. He can interact with the instructor via e-mail, Newsgroups, Weblogs etc but he can't interact with him in real time.

2.3.3 COMPUTER SUPPORTED COLLABORATIVE LEARNING APPROACH (CSCL)

This is an approach that is related to the principles and methods of instruction or a teaching method. In other words it can be said that it is a didactical approach of learning. In this mode, social interactions by means of Internet play a major role in learning. This kind of learning methodology can be implemented in any kind of learning environment- whether it is online teaching or it may be classroom teaching. The study of the Computer Supported Collaborative Learning (CSCL) draws the attention in a large variety of areas ranging from instructional technology to the psychology of society and education. It deals with collaborative learning and Computer Supported Co-operative Work (CSCW) which requires basically teamwork in order attain fruitful results.

As the reading of particular forms of learning, Computer Supported Collaborative Learning is thoroughly related with the education or pedagogy. This considers all stages of prescribed education from lower level to the higher level. The theme of promoting students to learn jointly in short groups has also become increasingly important in the broader sciences of learning since multiple efforts always give more efficiency than work at individual level. On the other hand, the capability to unite both the ideas (computer support and collaborative learning, or technology and education) to successfully improvise learning remains a objective that CSCL is designed to satisfy.

2.4 DISADVANTAGES OF THE e-LEARNING SYSTEMS

Some of the drawbacks of existing e-Learning systems are as follows:

1. Identification shortage of real problem in the design of the e-Learning systems.
2. Many of the learners may not be very well versed with the technology that is used for using the e-Learning systems and hence they might need to be trained for it.
3. There is lack of social interaction as compared to the traditional learning systems.
4. The existing systems do not consider the psychology of the students.

2.5 CONCLUSION

The chapter summarizes the concept of e-Learning systems, and how it has replaced the traditional learning system in higher level education. It highlights the characteristics and the various components of the e-Learning systems. There are some of the shortcomings of the existing systems that have been highlighted in this chapter and further work has been carried out in the following chapters to overcome some of the deficiencies of the existing systems.

CHAPTER 3

LITERATURE SURVEY

3.1 INTRODUCTION

The literature available in the areas of Activity Theory, Multi Agent Systems and Semantic Web with respect to e-Learning systems has been rigorously reviewed and is presented in brief in this chapter.

e-Learning spans a broad area of research varying from virtual classrooms to the distant courses or education in distance mode. Along with the emergence of latest technologies and Semantic Web, the e-Learning systems are achieving more significance day by day. The e-Learning system's applications in higher education is becoming extra prevalent in developing countries such as India. The methods used in learning by traditional manner can't be framed as per the preference of an individual while in the e-Learning; the contents could be made accessible according to the previous knowledge of the learner. A variety of definitions for the education in distance mode and distance learning have been anticipated in [1], [7], [8] & [9] related Web-based learning with the Web browser technology, frequently delivered through the intranets or Internet. There is a lot of literature related to e-Learning with Web-based learning present on various websites on the Internet. In [10] we refer to learning activities concerning networks of computer as e-Learning, and the stresses that e-Learning is not only a remote learning approach

or technique. The notion of learning in online mode predates the outer shell of the Web, but mainly fresh journals regarding on-line education resembles to resources given above the intranets or www. The research paper reviews the analysis works conceded out by various researchers in this specific area at the present.

3.2 A REVIEW OF THE EXISTING E-LEARING SYSTEMS

With immense progress in the tools, the conventional lecture-driven classrooms are providing means to fresh and supplementary active environment, at which the students can have right of entry to a extensive range of interactive and multimedia course resources. The two fold contribution of [11] is a fresh utilization of currently existing technology to advance education and a longitudinal quasi-experimental assessment of application of its in situation. Like a primary involvement, the authors set up an integrated setting that is intended to rally up the active learning priorities of learners of computer science engineering, in addition to a maintain for mutual learning. For the subsequent contribution, a number of experiments in classroom were performed.

Traditional learning is compared with the e-Learning System in [12]. Considering a survey comprising questionnaire and interviews, it has been concluded and proved that e-Learning is more beneficial over the traditional learning methods since its, ease of use, ubiquitous access facility and portability. With the reputation of education in distance mode, there is an growing interaction among the instructors and the students and among the students themselves. On the other hand, it is still complicated to tailor the teaching methodology and materials as per the students profile/ background as stated in [13]. Artificial Intelligence (AI) concepts

and approaches have been engaged to formulate e-Learning further effective and qualitative through considering earlier knowledge of students. The authors in [14] said that previous incident with the ICT and the virtual competence was two powerful parameters which had an impact and constructive influence on the e-Learning and its outcomes. With the use of social cognitive theory, authors reached inside the black box of the processes that are psychological in nature, in which e-learners operate. The analysis turned up in an added comprehensive account of the outcomes of ICT incident. Their findings bare that familiarity with the information looking for and interaction through ICT aided individuals to grow essential skills, which in turn permitted them to sense satisfactory with their practice and learn effectively. There is no uncertainty in saying that e-Learning proposal will endorse most straining person to obtain a few particular information and incorporate utilize the knowledge of the main communication. An orderly layout and the plan of implementation for training the communicational courses as achieving the training necessities of the communication engineering's learners foremost in the e-Learning surroundings has been projected in [15]. It is significant to relate the e-Learning proposal and e-Learning's sophisticated technology in order to educate the major of the communication. The authors investigate the e-Learning interface is based on the PET system be moderately soaring. The erudition curve is reasonably elevated in the I (first) XHTML as well as XML e-Learning Interactive software solution tool, and also in the II (second) software solution tool (the arithmetical tool for e-Learning) which is mentioned in [16]. It is understandable that the scholars are experienced with numerous choices and they want prior

knowledge in order to operate the software. An analysis demonstrates that on behalf of the III (third) software solution tool, system of Information Mining Courseware, where the learning curve is fairly flat and scholars are by now well-known with all concepts as the software tool itself was developed and aimed the user's knowledge stage. The study is proposed a fresh approach of handling the method of formation of solutions of e-Learning as interactive surroundings by means of undertaking as well as interacting the approach of software engineering which are based on indicators of the e-Learning. In [17], authors have recommended a modeling approach of an enveloping e-Learning application dependent on the high-level Petri Nets. The Authors have highlighted the significance of this novel striking mode in the education basing on the latest web services and communication technologies. The succeeding stage of the research concerns the execution of the proposed application. With existing powerful technologies such as, XML language, Java technologies and Oracle data base, the authors have implemented the application. The Learner as the subject matter of the e-Learning would too have a firm impact on the e-Learning [18]. But as time passes, it was revealed that there are many factors that in addition have the effect on the e-Learning, a number of scholars and experts began to study multiple factors' impact on e-Learning. Initially, it describes the factors that affects the quality of e-Learning, then it examines the role of learner and their input to e-Learning, compare with the multiple learners' behaviors on e-Learning, and mine the similarities and differences impact on their e-Learning, lastly, it shows some problems in the e-Learning and provide a few suggestions for enhancement. Now

days, the utilization of latest technologies and computers has become a significant feature of the education. An effort to inspect the conventional job of an instructor in the e-courses, manipulates and what are the preconditions that are necessary for the educating such sort of courses has been prepared in [19]. Also, it provides the details of the formation of the e-Learning courses as of the pedagogical point of sight. At last, several questions of practical e-tutoring running at a institution of higher education level in the British democracy have been observed. The progress of an e-Learning system imposes additional challenges for software tool developers, knowing that there are additional facets, for example tracking of clients along with contents, not typically considered in the software enhancement approaches [20]. The author’s methodology enriches the enhancement of the systems of e-Learning process predictable in the ADDIE by means of model-dependent development of the software excellence contemplation client's interfaces. Through this, they target at the development of a Model-Based Instructional Development Environment (MB-ISDE), in order to take account of the e-Learning development in existing trends of the model-based development of software. The e-Learning system's growth should be done by means of internationally recognized standards and safety methods. Information security can be achieved by means of methods such as network protocols cryptography. In [21], the authors have underlined some key security issues with the purpose of must be considered in developing and utilizing a platform of the e-Learning. A protected e-Learning platform should include all the factors of safety measures without disturbing any of the system efficiency.

The above discussed correlations among the three categories are useful in the rule of Web 3.0 using the Deontic Logic Verification for e-Learning.

3.3 E-LEARNING WITH WEB 2.0 FOCUSING ON SERVICE ORIENTED ARCHITECTURE

It is obvious that networking and training are the keys to progression and development of personal skills; and therefore the instructors require to be trained to innovate in the line with the enhancement in the technology and how technology can support in learning and teaching process differently than before. As such learning and teaching must be co-created among the teachers and learners and be viewed from the service oriented and participative approach [22]. The participative approach focuses on the learners' involvement in real life use where as the service oriented approach focuses on values that are co-created among instructors and learners to develop win-win perspectives for both the parties. Overall feedback is constructive both from the participating learners and lecturers. A theoretical Integrated Design Process (IDP) has been introduced to enhance the design methodology and utility of the WD2L background as a tool for learning support in [23]. Outcomes indicated that the projected IDP was effective in that the research showed (1) the WD2L environment's similarity to conventional supplemental learning, particularly as a supplemental learning program which is Web-based and user's positive perceptions about WD2L environment assets. The research has also verified that for an e-Learning atmosphere to be thriving a variety of aspects of the learning environment should be taken into account such as, conceptual learning theory application domain knowledge, instructional design,

evaluation and user interface design regarding the total quality of the learning environment. The principles and theories of the interface design on the courses of E-Learning have been discussed in [24]. Thus, the investigation about the design of interaction of the "College English Intensive Reading" and the implementation of their technology is performed. E-Learning courses, "College English Intensive Reading" also should present a few methods of interpersonal communication to cope up for the teachers along with the students in a non-learning content interaction. Interaction among students in collaborative learning has a significant contribution, Technologies of Web 2.0, could balance for the shortage of this. In [25], the discussed framework aims at the provision of an absolute adaptive, robust and integrated learning environment. The best part of the system is the quality to analyze the potential of the student and adaptive administration of the process of learning. An intellectual assessment engine generates assessments and quizzes as per the student's capability. The above framework aims to give an overall environment of learning in on-line mode. This paper has the theoretical architecture of the framework which is organized around the subsequent center features: (1) Capability Analysis of Student (2) Domain Specific Learning Services (3) Adaptive Lecture Authoring Tool with Notification Manager (4) User Friendly E-Learning Portal (5) Intelligent Assessment Engine. In [26], a thorough investigation of well recognized architectures intended for service oriented e-Learning system is concluded. The architectures gone through at this juncture provide users the capability to assemble, investigate, distribute and utilize learning knowledge from several sources of facts. This research paper has given a review

on the service oriented architecture for the e-Learning system which incorporates characteristics such as distributed, interoperable, extensible, adaptive dynamic, intelligence and collaborative, condition the architecture consists the semantic web technology plus suitable levels of security, the system will be extra resourceful. The e-Learning's Service-oriented architecture provides interactive, adaptable, distributed, extensible, intelligent and collaborative system of e-Learning to successfully appreciate the learning anywhere along with anytime to instructors as well as learners. The Software deployment in addition to code alterations and the maintenance could not be completed via crucial times. The additional years are software utilizes and alive the further time and expenditures are desired. The Linear dependency among realized modifications and expenditure is shifting into the exponential dependency, with the passing of years [27]. It is nothing familiar that upholding of inadequately or wrongly designed software tools (i.e. LMS) is able to attain the position when the price of new software development is lesser than the real maintenance charge. The input is an introduction and explanation into a good number of critical parts of software maintenance. Once more in [28], Model Driven Architecture has been discussed, designed, implemented and incorporated with the Service Oriented Architecture to develop a system that is bendable and which will change itself to the varying necessities. It also uses the emerging technologies like Web 3.0 and .NET in order to provide functionality in a proper manner; interoperability and reusability are the major aspects of developing such types of systems. The basic components of an e-Learning system have been developed by using J2EE and then they have been incorporated with the Web

based Services in [29]. Fundamentally, two models have been defined. One is the functional model containing a variety of components of an e-Learning system and second, a service model as a means of interaction between the Learning Management System and different Content Authoring Tools and. The authors have put more emphasis in [30], on the utilization of the learning content rather than the formation of the contents. The utilization of Learning Management and Knowledge Management is used collectively to study and share knowledge so as to perk up the performance of the learner. The use of Web 2.0 has provided various functionalities to the learner. In [31], a custom-made e-Learning system for the academic institutions that are using the software Adobe Flash has been designed keeping in view the user's requirements, his prior knowledge and proficiency in the related area. Considering these facts, the learning material is extracted and delivers to the learner. Suitable services are provided to the users till they achieved their learning goals.

3.4 e-LEARNING USING ACTIVITY THEORY

The perfection in e-Learning systems has initiated a uprising for instructional matter delivering, societal communiqué and education deeds following factor study, the attitude of learners is categorized into four different factors - e-Learning as an indicative surroundings, e-Learning as a novice independence upbringing, trainers as assisted tutors in e-Learning and lastly the e-Learning as a multimedia learning atmosphere. In addition, the study in [32] says- the activity theory is an apt theory for realizing the e-Learning systems. As of activity theory position, individuals aggressively raise their associates inside social realms.

The extensive use of technology and tools isn't an assurance for the creation of successful e-Learning systems as mentioned in [33]. A lot of technical and pedagogical issues must be addressed based on the dynamic perspective of learning. The suggestion in [33] utilizes the models to deal with troubles such as implementation, retrospection and modeling. It extracts the modeling concepts desired in the semantic of activity theory. Authors also have discussed the appropriateness of adaptive workflows as a metaphor to tackle educational scenarios. Bearing in mind the traces as primary rank entities can assist to put up reusable and flexible scenarios. Studying on-line learning scenarios since activity systems flee the idea of awareness as self-determining from the actors, like an objective resource for example any other; nor are data gained autonomously from act, an output of conversation as well as interpersonal speech single-handedly. Activity Theory provides a manner of synthesizing and constructing applicable notions as discussed in [34]. Activity theory realizes the temperament of realistic actions, the social beginning of realistic activities as well as the characteristics of the 'activity systems' within which the people work together. The e-Learning has been reframed by the Activity theory through modelling the repeated and rooted qualities of human actions, by enlightening the timid nature of knowledge and its course of action, furthermore by pointing the opportunities for the development of single person and group development or growth. The authors of the paper wrap up by reviewing implications for the knowledge work and the e-Learning. In [35], the authors projected a framework to examine factors affecting usefulness of e-Learning. Four hundred and forty-six learners have united the on-line teaching

curriculum in the Chai-Yi County. The outcome shows that e-Learning platform practice, learning motivation, former experience and attitude toward Internet were found to notably influence the effectiveness of e-Learning. An outline of the techniques and methods utilized to abstract contextually and pedagogically adept layout or blueprint necessities for an e-Learning atmosphere for aiding learning and training in most of the western country's high schools has been developed as discussed in [36]. It shows how pedagogical plus theoretical point of views can be included into the systems development procedure of fetching the requirements of design layout for an e-Learning atmosphere. This paper emphasizes on the fact which is major concern should not be put on the blueprint of interface alone, in its place, we must try to deal with the total perspective of use and kinds or sorts of communication which are rooted equally in jobs and in the users' accepting the events. The operational mapping tool and visual and conceptual complexity of the expanded activity triangle is taken to signify and correspond summary can potentially perplex and overwhelm with zero background in the assumption. Luckily, the tool for operational mapping provides an architecture and arrangement for summarizing resultants for stakeholders; though, this software tool by itself is not enough. It is discussed that how above mentioned approaches can notify instructional growth and design inside a distance teaching programs in [37]. Largely, AODM provides assurance as a measure for supporting the blueprint of practices of the e-Learning.

3.5 e-LEARNING USING MULTI AGENT SYSTEMS

We can define the software agent as a unit of data-processing that carries out in an

independent way tasks delegated through a user, except also a portion of the software tool which can perform or operate in place of another entity [38, 39]. The Software agents work in a particular ambiance (for instance an agent platform) that is frequently populated through further agents and methods. Preferably, software agents acquire knowledge from their functions, cooperate as well as communicate with the other software agents, in addition to, if necessary, proceeds within the region of networks on the www. Additionally, an intelligent software agent has distinctiveness such as potential to communicate (showing adaptive along with social conduct), mobility, and ability to work together, study and even reason, depending upon assured knowledge demonstrations as discussed in [39]. The authors evaluate here a few of the efforts finished by the researchers in context of e-Learning by means of Multi Agent Systems. The authors offered a few conceptual views on sophisticated future educational environments and the preliminary outcomes in multi-agent prototype formation in [40]. This venture is in growth and intended to provide customized and flexible educational services. The foremost guidelines of eLearning systems progress and stages of all direction are clear. The roles of intelligent agents and ontologies in these systems are renowned. The approach to development of tailored learning program using the Semantic Web technologies is projected. The anticipated system is offered in three points of views with the purpose to grant the domain explicit content to scholar based on the attempt prophecy as per their background information in [41]. Designs of an intelligent software agent, the realization of intelligent agent, structure of system and work process were given. Following the test utilization of

the system by some network school, it has been observed that system possibly will steps forward the learners' starting involvement that could give learners with customized service of comprehension. The generic approach for the augmentation of agent-based along with e-Learning intelligent system architectures which is service-oriented is discussed in [42]. In this paper, the authors suggests a generic agent-based and service-oriented methodology for the building of the e-Learning intelligent system architectures giving moveable right to use to electronic content (e-Content) along with electronic services (eServices) for scholars prepared with wireless equipments, through a group of Info-Stations implemented within key features in the region of a institution of higher education site. The methodology absorbs the thoughts recommended by the MDA arrangement of OMG. Through this approach, there are two prototype e-Learning applications, have been effectively deployed. An intelligent teaching module of the system has been recommended in [43]. In addition, a serviceable model of an intelligent education platform (also termed as INES), that has qualities allied to, LCMSs, ITSs along with LMSs like: learning tasks to the students and management of users and contents has been discussed. Therefore, a common purpose system development and design, able to adapt itself to precise requirements of teachers and students, by means of intelligent support to offer reasoned opinions at all time has been urbanized. The foremost future effort associated to the training module is to advance the astuteness. The domain ontology is supports as a learning tool and can also be engaged to evaluate skills of scholars [44]. The investigation of mistakes of students allows to suggest those customized advices or suggestions and to enhance

the course contents. In upcoming work, we graph to develop more influential algorithms for ontology analyses that take account of ontology integration and their scattered upgrade based upon the Multi-Agent methodologies. Parallel to the development of novel algorithms, it is desirable to attach additional dominant semantic likeness calculations for supporting bendable quantitative grading system. At last, additional effort will comprise studies on more intricate interactions amid the agents that compose the design.

3.6 WEB 3.0: A NEW DIMENSION TO e-LEARNING

In line with the growth of different web technologies and pioneering concepts of utilizing the web to its complete potential, the web is evolving rapidly in the direction to intelligent web systems. To map an improved future the web science requires being deliberate and understood as a total. The application developers and web page developers have a set of challenges to bear a high performance architecture which connects several services and servers, every geographically spread across the world. The conclusion has been made to report which protocols and web technologies succeeded in realizing the existing web and what is available to be the potential future web architecture and its social impact as mentioned in [45]. In [46], the author proposed the position of building of information of regional comprehensive academic institutions and investigates the theory of the web3.0 technologies. Also, they discuss the procedure of information construction of comprehensive academic institutions from the sight of web 3.0 which consists following three gears: teaching resources, information organization and learning atmosphere. Also, the scholar pursues the similar standard throughout giving their

resources to the library. Lastly every resource in the library is kept in an logical style with a consistent standard and keep a protected and close link among different types of contents and resources. The author discussed three categories of applications of semantic web for namely learning objects, education, learning pedagogical agents and object repositories significantly appraises their input to instructors and learners alike in [47]. Additionally, the terms mentioned inside the ontology have to explain solid data, by any one of the accessible ontology languages and, to ensure its effectiveness, one wants to extensively check it probing the extracted knowledge. The author is unfolding a learning object clearly, by consistent and multidimensional metadata having exacting significance intended for the thriving execution of the semantic web in tutoring in this research paper. The Web 3.0 application becomes vital in favor of the present expansion of social groups; this mechanism supports us on the way to expand added applications in forthcoming future. In [48], in favor of the plan of commendation method, Fuzzy Theorem plus Bayesian Theorem were taken into account to get the recommendation method of articles site associates and hobby associates. The major concept is to utilize the attributes of API of social network and Giant Global Graph to integrate associates from dissimilar societal platforms and to further form high proficient interactive mechanisms like competence by blogs of interests, building reference of hobby associates and top collections, collections of external membership, cooperative redactions, personal recommendations and real-time chat rooms. As an initial step, eLearning model for interview training is deployed in [49] wherein the learning objects are integrated in RDF data model similar to the

defined ontology and facilitating the user a flexible exploration. As an initial step in a hierarchy of enriched environment for knowledge enhancement, this paper outfit a means for enhancing a sophisticated explores retrieving no more than the most pertinent links eliminating the additional links by means of the semantic web technologies. The sound refined explore mechanism is developed in and what the user desires is all provided in a integrated manner to them removing all the inappropriate links.

The e-Learning system model that utilizes the agents of e-Learning which is based on semantic web is discussed in [50]. The research reveals how to pull out the valuable information on the web as well as provides the external knowledge on the subject of semantic web and its types. The most important purpose of this model is to create an e-Learning system that is customized as per individual's requirements so that everybody is able to make its complete utilization. The agents of e-Learning agents such as Instruction Agent, Lesson Planning Agent, Resource Location Agent, Learner Centered Agent and Collaboration Agent with Personalization Agent are used to illustrate an e-Learning system.. A grid-based Semantic e-Learning Framework has been explained in [51]. SELF focuses to recognize the key-enablers in a realistic e-Learning situation which is grid-based furthermore reduces technological reworking through offering a well-defined interaction plan amid presently existing technologies as well as tools. An efficient, back-to-back as well as practical e-Learning atmosphere can’t be realized via a loose integration of existing methodologies or else by initiating the development from the beginning. An effort to evolve a back-to-back e-Learning architecture

from the combination of existing technologies, mainly the semantic web, customization along with collaborative tools, and the grid as well as knowledge management techniques has been finished. In [52] the offered concept is an effort to commence a learning system which combines Web 3.0 technologies to attain enhanced usability and personalization. Furthermore, technologies like, WWW and Artificial Intelligence have swiftly evolved over the last several years. In spite of this condition, educational concepts haven't been developed. The previous few years, a bunch of appealing on-line services have been offered to the community. Synchronous/Asynchronous conversations, On-line video conferencing, wikis and social networking are presently a one of those technologies which altered the way people observe and utilize the Internet. By the combination of the characteristics mentioned above, the system becomes capable to attain a customized interactivity with each learner. Moreover, the social networking features will add in gaining broad satisfaction and approval. The analysis in [53] shows the notion of Web 3.0 and Semantic Web technologies, which could be a distinguishing achievement factor in the present competitive e-business marketplace for companies presently positioned with the Web 3.0 technology. It describes the progress of Web 3.0 in favor of the formation of value and new developing business models, its multiple properties, and its main differences with the Web 2.0 technology. In addition, the paper suggests eight direct or indirect returns based business models that have diverse levels of openness that an organization can pursue to adapt a successful Web 3.0 based business policy. A Web Service Oriented ensuring the solitude of e-Learning content has been suggested for designing an e-Learning system in [54]. It

focuses at integrating each components of e-Learning system in order to facilitate both the learner and service provider by utilization of Web Services as an interface. Stress has been made to build the system interoperable and reusable. A modular Semantic Web based interoperability framework has been suggested for the integration of the different functionalities and educational contents of an e-Learning System. In addition, importance has been given on the research of e-Learning contents by making utilization of ontology driven authoring tools as mentioned in [55].

3.7 CONCLUSION

In this chapter the literature review of the recent approaches for the development of e-Learning systems has been performed, exclusively in the last ten years. Primarily, the long-established learning systems were used but because of lack of inherent capabilities in the traditional methods, they were replaced by e-Learning systems employing various mechanisms such as Activity Theory, Semantic Web and Multi Agent Systems. This chapter analyzes these methodologies in two different parts [56]: the primary part introduces Activity Theory and Multi Agent Systems; the second part gives an overview of Semantic Web for machine understanding.

CHAPTER 4

INTRODUCTION TO INTEGRATED e-LEARNING SYSTEMS

4.1 INTRODUCTION

The discussion in the previous chapters provide a critique of the current state of e-Learning, arguing that it is a complex social phenomenon that requires a deep understanding of the relationships between different phenomenal levels [57], the value- laden nature of technology and its interaction with the surrounding educational culture [58], the interrelations between key factors in real-life e-Learning contexts [59], and the temporal, situational, social, and cultural nature of online participation [60]. A crucial issue in the design of e-Learning Systems is how to conceptualize the term participation in a way that embraces this complexity. The notion of Activity Theory is well positioned to provide a powerful and expansive unit of analysis which can address this issue.

Firstly, an introduction to Activity Theory has been given in relation to first, second, and third generation perspectives of Activity Theory. Following this, we will discuss the use of Activity Theory as a research tool including an overview of uses of Activity Theory within educational research. A discussion of the use of activity as the participatory unit of analysis, and methodological implications for this inquiry.

A brief introduction to Multi-Agent Systems is given thereafter followed by Semantic Web. Semantic Web is an emerging technology that is used to develop e-Learning framework. The chapter will conclude with a brief introduction to the evolution of semantic Web and its application in e-Learning Systems.

4.2 ACTIVITY THEORY : A BRIEF INTRODUCTION

In order to design a good e-Learning framework, the focus should not entirely be upon the educational content that is designed for a particular course or upon the ways by which human computer interactions will take place. The entire learning activity should be the main unit should encompass all the human aspects, social interactions and the production rules that will govern the activity of interest. Activity Theory is best suitable for such kind of data abstractions. It considers each learning situation as an activity that is designed to accomplish a certain goal such as acquisition of knowledge by a learner or transmission of knowledge by a tutor. Each learning activity has a community of tutors, administrators, learners etc who are governed by certain rules. A set of tools such as software, text documents, computers etc is required to fulfill the activity. Activity is partitioned into sub activities that are carried out by different group of people and this is termed as Division of Labor Underpinned by the socio-historical branch of Soviet psychology represented primarily by the work of Vygotsky [61,62]. The theory of Activity demonstrates the significance of the society in formulating the individualsmind and it gives an analysis unit for comprehending human consciousness [63]. The basic claim of Activity Theory is that the human mind exists and grows and it can be understood only in the perspective of human

interfacing with the world; and this communication with the world or the activity is either culturally or socially determined [64].

The work of Vygotsky [61,62] has contributed to the ongoing search for an appropriate unit of analysis to understand the relationship amongst the internal world of human perception and the exterior world. Activity theory transcends dualist theories that separate mental and physical dimensions by using the concept of activity as the minimal meaningful unit of analysis [65]. During the activity process, the subject creates internal representations of the object and concurrently objectifies its internal representations [66], thus inner world of the mind is united with the external world. Consciousness is situated within everyday activity in the real world-you are what you do [67].

The history of activity theory can be represented by three distinct generations [68]. The first generation was characterized by work on mediation by Vygotsky [61]; the second expanded the unit of analysis to include the social interactions [69, 70]; and the third generation expanded the minimal unit of analysis to include the two activity systems [68].

4.2.1 FIRST GENERATION ACTIVITY THEORY: THE CONCEPT OF CULTURAL MEDIATION

Central to the work of Vygotsky [61] is the belief that the human mind is mediated by a third element, that is, humans have access to the world only indirectly, or mediately, rather than directly, or immediately [71]. The theory of mediated activity as the unit of analysis contributed significantly to the psychology as it means that we cannot understand an without his or her cultural means; and the

society cannot be further understood devoid of the group of individuals who make use of and generate artifacts [68]. Human consciousness (which includes voluntary attention, planning, problem solving, evaluation, conceptual thought, logical memory, and learning) is mediated by cultural artifacts [63, 64]. The deployment of synthetic means and the transition to mediated activity, basically changes all psychological actions just as the use of tools significantly expands the variety of activities within which the new psychological functions may operate.

In this context, we can use the term higher psychological function, or higher behavior as referring to the combination of tool and sign in psychological activity [61]. Therefore, an individual transforms an object i.e., the raw material or the problem statement at which the activity is targeted into an outcome by using various physical and symbolic tools [72]. These cultural artifacts can be physical tools (for example, a computer) which are outwardly oriented or symbolic tools (for example, strategies, arithmetic, language, and signs) which are more inwardly oriented [65]. Symbolic tools are directed towards mediating the mental processes of the individual and physical tools are used to shape the environment outside the individual [63]. For example, a student writes an essay (object) by using a laptop (physical tool) and the English language (a symbolic tool). In the educational domain, learning as a form of consciousness always involves the use of cultural tools, in other words, learning has to do with how people appropriate and master tools for thinking and acting that exist in a given culture or society [73].

An essential point to grasp is that by using a cultural artifact tools and the knowledge pertinent to their continued use are passed from generation to

generation [74]. The cultural artifact, embedded within specific social contexts, is infused with specific cultural and historical conditions of its environment [63]. Thus, by engaging in mediated activity and using a cultural artifact, activity becomes a collective process which is or has been shared by others.

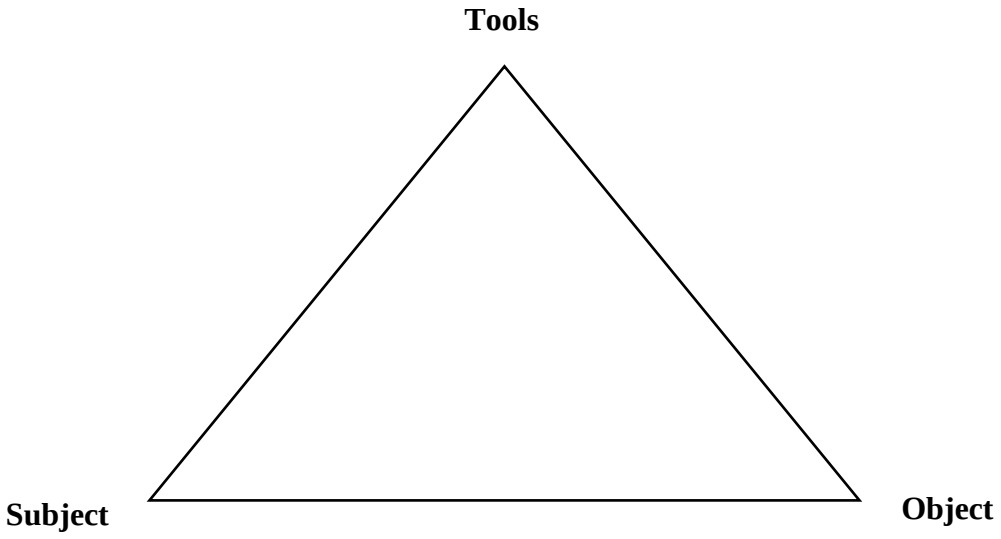

Fig 4.1: First Generation Activity Theory

The point is expressed very powerfully by Cole and Engestrom [65]:

The civilizing environment in which the children are born contains the knowledge that is accumulated from the prior generations. In mediating their conduct through these objects, human beings gain not only from their own experience, but also from the culture inherited by them from their forefathers, that is we can say that the history prevails in the present [65]. A central principle of Activity Theory is that tools mediate or shape both human activity and mental development [75]. As the human mind operates through cultural artifacts, the artifacts shape the experience by setting the conditions under which it will proceed. Additionally, the interactions between the subject, tool, and object move in both directions. Cultural

mediation has a recursive, bi-directional effect. Both the environment and the subject are modified by the mediated activity [65]. For example, the use of email sets conditions such as time-delayed communication and dependence on reading and writing for the exchange of information between people to occur. However, the use of the tool also affects how the subject chooses to carry out the activity as it may offer the individual new opportunities for communication in other contexts or new ways of understanding the world [63]. Through the concept of mediated activity, attention is redirected away from individuals, their tools and properties, toward what people do when they use a tool, and how they and the outcome of the activity are affected by using the tool.

4.2.1.1 THE ZONE OF PROXIMAL DEVELOPMENT

In order to explain the social nature of cognition and the relationship between the individual and the world, Vygotsky [61] advanced the concept of the zone of proximal development (ZPD) [74]. The ZPD is the distance between what an individual can accomplish alone and what an individual can accomplish with assistance from more capable peers [71,74]. Vygotsky [61] states that every task in the child‘s cultural development appears twice: firstly, on the social level, and later, on the individual level or we can say that it first appears between the people (inter-psychological), and then it appears inside the child (intra-psychological) [61]. Learning can be conceptualized as originating from social interaction between people (inter-mental) as they interact in cultural environments and employ various cultural artifacts before being internalized (intra-mental) by the individual [74]. Vygotsky understood internalization to mean a process whereby

certain aspects of patterns of activity that had been performed on an external plane come to be executed on an internal plane [71]. Learning is distributed between two people functioning as the expert and novice, and language mediates their relationship [63]. It is important to observe that Vygotsky viewed the ZPD as encompassing a restricted area, in other words, collaboration with a more capable individual must be set at an acceptable level. Therefore, instruction is good only when it proceeds ahead of development, when it awakens and rouses to life those functions that are in the process of maturing or in the zone of proximal development [76].

4.2.2 SECOND GENERATION ACTIVITY THEORY: RELATING THE INDIVIDUAL TO THE COLLECTIVE

As per the note of Barab et al. [74] , Vygotsky did not fully develop the concept of activity in his brief lifetime; thus, the task of articulating the nature of activity fell to his colleague Leontev [70]. Leontev focused on the object of activity, proposing that activities are differentiated by the objects they pursue [74].

Additionally, he created a distinction between immediate goals and overall goals of activity by representing activity as a three tiered hierarchy: operation, action, and activity. At the highest level is the activity that provides the overall motive – to transform the object into an outcome. An activity is composed of actions of which individuals are consciously aware and they are often associated with skills and knowledge. In turn, actions are composed of operations which are automatic routines influenced by conditions in the setting. Leontev [70] illustrates these abstract concepts with an example of hunters searching for food. The activity is

motivated by the overall need to find food for the group; however, each member performs specific actions to realize this need. For example, one hunter might beat a drum to scare animals towards other hunters (an action). Taken in isolation, the action of drum beating appears to be disconnected from the need to obtain food; however, when viewed as a step in a wider activity, the meaning of the action becomes clear.

Actions are in turn composed of operations, such as beating the drum or walking, and these operations are shaped by conditions such as the construction of the drum and drumstick and the nature of the climate and physical surroundings [74]. Thus, Leontev illustrated the difference between individual and collective actions and how they relate to one another [68].

Leontev's hierarchy can be extended to learning settings [70]. A group of students may be focused on working with others in order to create an oral presentation a collective object which is shared with the immediate group (the community). However, while the activity is oriented toward a collective object, the actual work consists of numerous individual actions such as searching for and evaluating academic literature in order to contribute to group discussions about the construction of the presentation. In turn, these individual actions consist of a myriad of operations which occur as habitual routines, such as typing, reading, and navigating through websites. These operations are shaped by conditions in the setting. For example, typing usually requires an individual to sit down, look at a computer screen and depress various keys. If the computer‘s battery is empty and there is no electrical outlet nearby, no typing can occur and the activity stalls. In

addition, if an individual has limited typing skills, typing may move upwards and become a conscious action requiring a degree of effort and attention rather than being an automatic process. Leontev's conceptualization not only draws attention to how learning activities can be decomposed into sub-components but also shows how individual activity is simultaneously both individual and collective.

Leontev's [70] ideas were used by Engestrom [69] who developed a structure for organization and it is called Activity Theory. It is used to illustrate graphically the function of cultural mediation, the social-cultural-historical context of activity, and what relationship holds between the individual and the group. Activity Theory proposes that activity systems are the fundamental unit of investigation for studying the behavior of human. These systems are accustomed systems of the relationships among individuals and their proximally cultural structured surroundings [65]. Thus, the minimal meaningful unit of analysis is widened from a focus on individual actions and processes to activity systems [77]. Building on the work of Vygotsky [61], activity theory represents the basic relationship involving a subject (individual or group) motivated by a need to transform an object (a goal, objective, purpose, or problem) and employing a cultural artifact (a physical or mental tool) in the process [74]. However, Vygotsky's [61] basic representation of activity did not fully account for the relationship between an individual and the environment. To rectify this, Engestrom [69] contextualized activity by defining activity systems using six components: subject, object, tools and artifacts, community, rules, and division of labor. Under this conceptualization, individual actions are now embedded within and obtain

smeaning from a community of people who are directed towards the same object. All activities are object oriented, in other words, they are forms of doing, directed towards an object. Object-orientedness [64,78,79] means that each and every activity is aimed towards something that exists in the world objectively, that is, an object. The object is the raw material or problem space at which the activity is heading for and which is molded or altered into outcomes with the help of objective and representative, external and internal tools (mediating instruments and signs) [72]. Objects can be considered powerful sense makers [80] as they give meaning to an activity. An object of an activity can be anything if it can be transformed by the subject(s) for example, it can be physical (a fruit garden), virtual (a website), or conceptual (a theory). The requirement of transforming the object into an outcome drives the activity [81], in other words, people/subjects are motivated to engage in activities because they have unmet needs and perceive that the activity will meet these needs. Intentions or reasons that motivate a person to participate in an activity are embedded within the meanings ascribed to the object [79,82] and intentionality plays a key role in shaping how people relate to the object. Before engaging in activity, people often have tentative plans and objectives which they use to orient their activity [79]. In addition, once the subjects begin to transform the object into an outcome, the intentions of the activity system are manifest [83]. In other words, people draw upon their intentions or objectives to make sense of the object, and these intentions shape the transformation of the object into an outcome.

Mediation occurs between the various components of the activity system through

third parties [81]. The rules of behavior mediate the relationship between the community and the subject. These rules can be considered as explicit or implicit norms and are conventions governing social interactions. Division of Labor mediates the relationship between the community and object. It represents implicit and explicit organization of a community as compared to the transformation process of the object into the outcome [77]. By adding the community and mediating artifacts (rules and the division of labor), Activity Theory shows how human behavior is socially bound and depicts the unification of consciousness and activity or thinking and doing. Acting and consciousness or acting and learning are tightly bound together [78] as shown below in Fig 4.2.

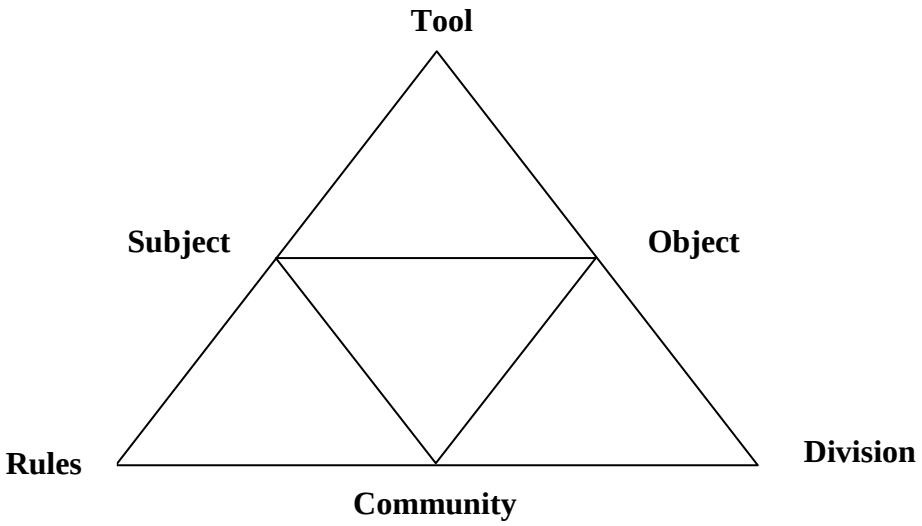

Fig 4.2 : Second Generation Activity Theory

Under an activity theory perspective, learning is re-conceptualized as learning to participate in a cultural practice [84]. On the individual plane, the learner (subject) is directed towards the teacher-designed learning activity (object). The expectation of engaging in the activity is to realize an objective such as the occurrence of

learning [85] or simply successful completion of the task [86]. The learner draws upon a variety of shared cultural tools (for example, learning strategies, computers, and paper) to realize the outcome, and these tools shape how the learning task proceeds and the nature of the outcome.

However, the learner does not act in isolation, but rather shares the learning task (object) and various tools with other students and the teacher who represent the community [86]. Finally, the learner relates to the community through norms of behavior and codes of practice (rules) and understandings about how the work is to be divided amongst the participants (division of labor) [86].

4.2.2.1 CONTRADICTIONS WITHIN ACTIVITY SYSTEMS

Contradictions are central components of activity systems and are manifested as problems, tensions, conflicts, or breakdowns within the activity system or between different systems [81]. Infact, the stable activity systems which are deficient in stress points are exceptions and tensions. Instability and local innovations are the rule and the engine of change [65]. Therefore, contradictions should not be viewed in a negative light, but as problems requiring solutions which lead to transformation in activity [77]. Contradictions can exist at various levels of the activity system within each node of an activity system (for example, tensions within the subject), between nodes (for example, between the community and the division of labor) or between different activity systems (for example, between the workplace and university) [74]. A contradiction between nodes could develop when a new tool is introduced into a community which lacks understanding of how to use it. Within the hospital context, one can envision new blood transfusion

equipment being introduced into a busy hospital unit which languishes because none of the nurses has been taught how to use it. In this situation, there is a tension between quality patient care (the main motive and object of the activity system) and the presence of an unused tool offering functionality which could potentially enhance care. Through contradictions, stresses and tensions develop within activity systems that may lead some individuals to question the status quo and deviate from expected norms. At times, this can develop into a collective endeavor to change the activity into a process called expansive transformation [68]. This transformation is attained when the intention of the activity and the object are the object and objective of the activity is reconceptualised to hold a drastically large perspective of potentials than in the earlier approach of the activity [68].

4.2.3 THIRD GENERATION ACTIVITY THEORY: INTER-ACTIVITY PERSPECTIVES

As new perspectives have been brought to Activity Theory, researchers have observed that activities are not isolated units but they are like nodes that are interconnected in a hierarchy in a network. Activities are influenced by other activities and by the changes that occur in the environment [81]. In response to these observations, third generation Activity Theory expands the analysis unit from one activity system to at least two activity systems that interact with each other as the minimal unit of analysis [68]. For example, Engestrom has investigated the relationships and tensions between multiple activity systems in a healthcare system, and has sought ways to transform working practices to resolve

contradictions in patient care. The third generation activity theory is shown below in Fig 4.3.

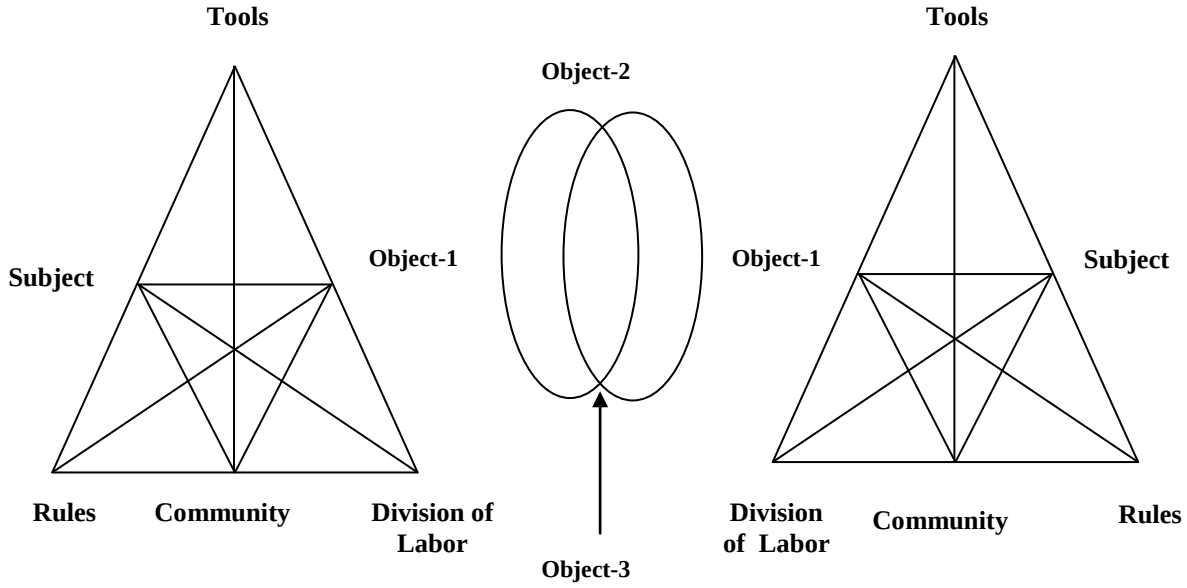

Fig 4.3 Third Generation Activity System Model

Applying this perspective, we can reconceptualise the relationship that exists between the various spaces such as college and the work settings can be reconceptualised as the interaction between the different activity systems [88,89]. Thus, the new analysis unit expands from a single activity system to greater than or equal to two or more collaborating activity systems that are embedded in a social, cultural and historical process [88]. This theory of learning across the boundaries of two or more than two activity systems [68] has been employed in the area of higher education to relate the linking between the work and the university [89]. After analyzing the experiences of various students who are concurrently working as lecturers and also studying in a faculty development course, Finlay [89] made the observation that the students applying a variety of tools such as thoughts, teaching aids, and theories from the learning environment

to aid them in the workplace. Finlay argued that the transition from an activity system workplace to a university system provides the students with a number of tools which were considered as resources in the workplace, and this created chances for learning. Thus, third generation activity theory offers useful perspectives by expanding the field of vision from the inner workings of individual activity systems to the relationships between two or more activity systems.

This section has introduced activity theory by describing three generations of scholarship. The original concept of mediated activity developed by Vygotsky [61] has been developed and expanded by neo-Vygotskian scholars to encompass collective aspects of activity and inter-activity dimensions. In the next section, the implications of using activity theory as a research tool will be considered.

4.3 ACTIVITY THEORY AS A RESEARCH TOOL

This section considers the use of activity theory as a research tool from a number of perspectives and will include a brief overview of Activity Theory within educational research, a discussion of the use of activity as the participatory unit of analysis, and methodological implications for this inquiry.

Activity is not a theory in the classical sense instead it consists of a set of basic principles which comprise of a general conceptual system that can be used as a basis for more specific theories. According to Nardi [67] Activity Theory can be considered as a powerful descriptive tool rather than a strongly predictive theory. It does not offer the tools and techniques required for research, instead the concepts of activity theory are to be applied to the specific subject under study [67].

Activity Theory has been a topic of great interest among various scholars doing research in the field of Human Computer Interaction as the computers can be viewed as tools that assist in performing human activity. Gradually the laboratory based research was converted in examining the ways in which the computers can be used to carry out activities within a social context such as Computer Supported Collaborative Working (CSCW) and Computer Supported Collaborative Learning (CSCL).

Activity was theory originated in the cultural historical psychology in Russia in 1920s and 1930s. Vygotsky was the discoverer of cultural historical psychology and Leontev, who was a colleague of Vygotsky, is generally attributed as the founder of activity theory. Activity theory is sometimes referred to as cultural historical activity theory, CHAT, to emphasize the links between the two. Vygotsky's notion was that culture and society are not external to the mind, but instead they are part of the way that the mind is formed [64]. Thus cultural historical psychology proposes the notion that human beings appropriate the meaning and values that exist in the world around us and that from these develop our own meanings and values. This idea of “non-straight forward, dialectical cultural determination of mind” [64] gave rise to a set of concepts, principles and research methods. In recent year’s activity theory has been developed from its origins as a theory for understanding human psychology to a tool to understand socially and organizationally orientated problems.

The generation one of Activity Theory (AT) depicts activity at an individual level (Fig 4.1). According to the first generation of Activity Theory, there are tools

(artifacts) that act as a link between the subject and the object. These tools (artifacts) can be either physical tools, language or symbols that are created and further altered in the course of an activity.

The second generation of Activity Theory (Fig 4.2) demonstrates activity at a collective level. The norms can be implicit or explicit. Division of labor refers to the manner in which the community of the activity is organized either explicitly or implicitly. On the basis of the elements of the above two generations of Activity Theory (Fig 4.3), [90] formed a list of eight questions that are to be addressed when we investigate a system that can provide an opportunity to identify the tensions and contradictions within a single activity system.

The third generation of Activity Theory represents a network of activity and it incorporates the notions of boundary objects as depicted in Fig 4.3, that is, the objects that operate at the boundary of several contexts [91]. There may be certain contradictions and tensions when two or more than two activity systems come into contact with each other. Activity Theory gives an opportunity to make explicit decisions, and furthermore helps to understand in a better way that what happens when two activity systems come into contact. There is capacity for expanding learning [68].

Activity Theory supplies a common glossary to define the technological, organizational, and pedagogic perspectives that have been proposed by [92] in terms of subjects, object, outcome, tools, rules, community and division of labor. If it is assumed that the each object of the activity system leads to an increase in the outcome of the organisation for e-Learning. The outcome of the organizational

activity system that we desire is its organizational sustainability. The activity system in technicality is largely represented by the specialists in information technology whose main responsibility is for the growth of the organization (both administrative and teaching) sustainability. The educational activity system that is represented by the ones with primary responsibility for teaching and learning will require a meticulous and sustainable methodology.

4.4 PRINCIPLES OF ACTIVITY THEORY

- **Object Orientedness:** Human beings live in reality with a certain objective. The things that constitute this reality not only have the properties that can be considered objective scientifically but they have socially and culturally defined properties as well.
- **Internalization/Externalization:** Internal activities cannot be completely separated from external activities. They are reliant on each other as they transform into one another. By internalization we mean the conversion of external activities into internal ones. Internalization is a method by means of which people strive for potential interactions with reality without performing actual manipulation with real objects. Externalization transforms internal activities into internal ones. It converts internal activities into external ones. Externalization is essential when several activities are being carried out between a group of people and they need to be synchronized.
- **Mediation:** Activity Theory states that the human activity is mediated by tools. Tools are formed and transformed during the progress of an activity.

The use of tools affects the nature of external behavior and the internal functioning of individuals.

- **Development:** It does not only mean the object of the activity but it can also be understood as the research methodology. It does not refer to the laboratory experiments; instead it stands for the formative experiments which merge active participation with monitoring changes of the participants.

The above principles must be considered as an integrated system as they are concerned with the various aspects of the whole activity.

4.5 INTRODUCTION TO MULTIAGENT SYSTEMS

In the field of artificial intelligence the research on agent-based systems has emerged as a new prototype for conceptualizing, developing and implementing the software systems. The Agents are complicated computerized programs that act independently on the behalf of their users to solve increasing number of complex problems across open and distributed environments. However, many applications nowadays require multiple agents that can act simultaneously. The multi-agent system (MAS) is a loose coupled network of the software agents that communicate with each other to solve those problems that are beyond the problem solving ability of the human beings.

A Multi agent system contains several autonomous entities possessing diverse information and/or diverging interests. Aim of the multi-agent systems is to simplify the co-ordination between independent processes. A computerized entity like a computer program or a robot can be considered as an agent. An agent is said

to be autonomous because it adapts itself according to the situation in hand. A multi-agent system can be defined as a system that is made up of a group of computer processes that occur simultaneously that is more than one agent interact with each other at the same time and share a set of resources in a distributed manner. The key consideration in the design of multi-agent systems is to sanctify the synchronization between the different interacting agents. Hence, muti-agent systems can be applied in the following areas:

1. **Decision-making**: It is concerned with the various decision making mechanisms that are available to the agent. It decides the interconnections between their perceptions, representations, and actions.
2. **Control**: It determines that what hierarchical relationships exist between the different agents and how can them be synchronized.
3. **Communication**: It refers to the kind of messages that are exchanged between the different agents when they interact with each other. The messages are syntactically and semantically defined.

Multi-agent systems can be applied in the field of artificial intelligence. The complex task is simplified by dividing it into smaller sub problems and hence distributing the existing knowledge into various independent agents for solving each of these sub problems. These agents use the accumulated knowledge and interact with each other. This process is referred to as distributed artificial intelligence. This method can be adopted for monitoring an industrial process, for example, when the sensible solution -that of coordinating several specialized monitors rather than a single omniscient one- is adopted.

The study of Multi Agent Systems (MAS) aims at the systems in which various intelligent agents can interact with each other either in a selfish manner or co-operative manner. The agents can be thought of to be independent entities, such as software programs or robots. They can share a common objective for example an ant colony, or they can follow their own interests such as in the free market economy.

The MAS researchers develop interaction protocols, agent architectures and communications languages and that helps in the development of the multi agent systems.

4.5.1 ADVANTAGES OF MULTI AGENT SYSTEMS

The MAS has the following benefits over a centralized approach or single agent:

- The MAS distributes computational resources and capabilities across an interconnected agent's network. But a centralized system could be plagued by critical failures, performance bottlenecks or resource limitations. The MAS is decentralized and hence doesn't go through from the "single point of failure" crisis related with the centralized systems.
- The MAS allows for the interoperation and interconnection of multiple existing legacy systems. With developing an agent wrapper around such systems, they may be included into an agent society.
- The MAS models troubles in the form of independent communicating component-agents, which is proving to be an extra natural method of representing team planning, task allocation, environments and user preferences, open etc.

- The MAS expertly extracts, refines, and worldwide coordinates the information from the sources that are distributed spatially.
- The MAS gives the solutions in conditions where expertise is temporally and spatially distributed.
- The MAS improves overall performance of the system, especially with the dimensions of computational efficiency, extensibility, reliability, robustness, responsiveness, maintainability, reuse and flexibility.

4.5.2 CHARACTERISTICS OF MULTI AGENT SYSTEMS

1. **Reactivity:** It refers to the agent's ability to perceive its environment and respond to changes that occur in order to achieve its design goals.
2. **Pro-activeness:** It is the agent's ability to take the initiative in its environment in order to achieve its design goals.
3. **Social Ability:** It alludes to the collaborative nature of the agent.

4.6 INTRODUCTION TO SEMANTIC WEB

The World Wide Web commonly known by Web, the biggest information construct has much growth from its beginning. Although it is not synonymous with Internet but it is the most essential constituent of the Internet that can be considered as a techno-social system that is able to communicate with the humans based on the technological networks. The techno-social system essentially refers to the system that improves the human communication, cognition and co-operation. The Cognition is the essential pre requisite to interact and the pre condition to co-operate. Therefore, we can state that co-operation requires communication and communication requires cognition. The Web is the leading transformable construct

of information and its thought was given by Tim Burners Lee in 1989 [93, 94]. There has been a lot of progress in the area of the Web and its associated technologies in the past two decades. We can say that Web 1.0 is a web of cognition, Web 2.0 is a web of interaction, Web 3.0 is a web of co-ordination and Web 4.0 is a web of amalgamation of the four generations of Web since the advent of Web.

4.6.1 WEB 1.0

The Web 1.0 is the foremost generation of the Web created in 1989 by Tim Berners-Lee. He recommended developing a worldwide hypertext space in which any network reachable information can be accessed. It can be considered as the read-only Web as well as the system of cognition [93]. It is stationary and to some extent mono-directional. The Businesses can offer brochures or catalogs to demonstrate their productions with the Web and the people can read them and get in touch with the businesses. The websites comprise static HTML pages that are updated occasionally. The major objective of the websites is to issue the information for anybody at anytime and set up an online occurrence. Those websites were not dynamic and might be considered as leaflets only. The users of these websites can just access these websites with no contributions or impacts and the connecting structure was also very pathetic. The central protocols of Web 1.0 were HTML, HTTP and URI.

4.6.2 WEB 2.0

The term Web 2.0 was officially defined by Dale Doughtery, Vice President of O'Reilly Media in the year 2004 [95]. Tim O'Reilly defines Web 2.0 as follows

[95]: "The Web 2.0 is the trade revolution in the computer business due to shift to the Internet as a platform, and an effort to realize the protocols for success on that fresh platform. Principal among those rules is this: Develop applications that bind network effects to get enhanced, the more people use them".

The Web 2.0 is also referred as the people-centric web, wisdom web, people-centric web and participative web. Through writing as well as reading, the Web might turn into bi-directional. The Web 2.0 is platform where the users can depart a lot of the controls they have been utilized to in the Web 1.0. We can say it also as, the users of the Web 2.0 have additional interaction with a reduced amount of control. The creative reuse, flexible design, updates, modification collaborative content creation were facilitated by Web 2.0. The one of the exceptional characteristics of Web 2.0 is to maintain collaboration and to assist to collect collective intelligence instead of Web 1.0 [96]. The major services and technologies of Web 2.0 comprise Really Simple Syndication (RSS), blogs, tags, wikis, mash ups, tag clouds and folksonomy. The Developers make use of the three fundamental development ways to design the applications of Web 2.0: XML (AJAX) and Asynchronous Java Script, Google Web Toolkit and Flex [96].

4.6.3 SEMANTIC WEB OR WEB 3.0

The Semantic Web represents the next major evolution in connecting information. John Markoff of the New York Times christened Web 3.0 as the third generation of the Web in 2006 [97]. Starting from, as a methodology utilized as machine interpretable data by means of the new generation software, the Web 3.0 is also referred by its assumed name as the Semantic Web. It has grown itself into a group

of standards that support open data formats and at the same time processes the information that emphasizes information instead of mere processing. The major goal of Web 3.0 is to describe a structure of the data and offer its connecting so that it is easy to find out, automate, reuse and integrate the data across a variety of applications. The layered architecture [98] was proposed by Tim Berners-Lee for the Semantic Web as shown in Fig 4.4.

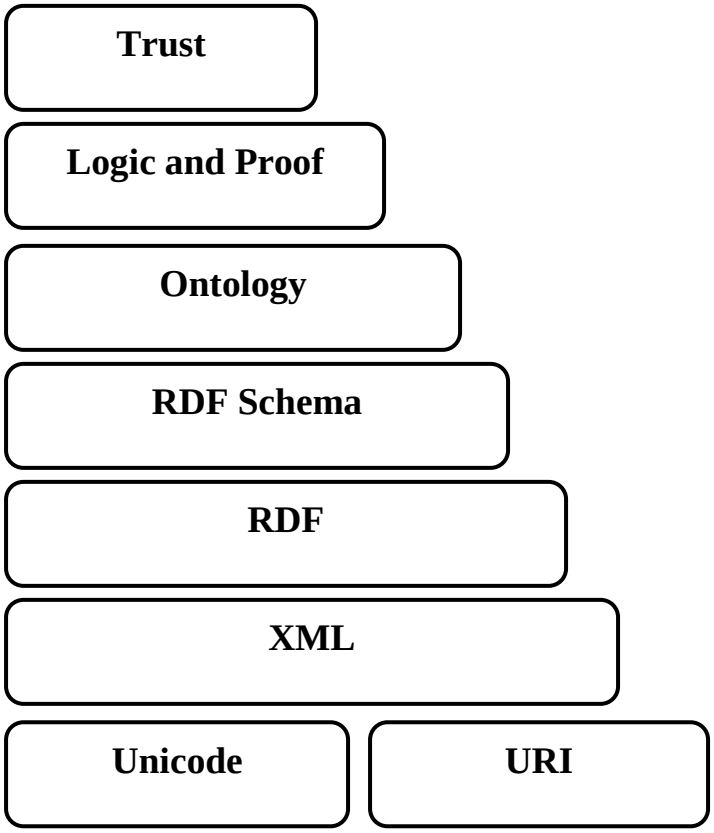

Fig 4.4: Semantic Web Layered Architecture [98]

The major thought behind the semantics in the Web 3.0 was the formation of Web content through not using the natural language but a type of script that can be understood and gauged by the software agents to allow them to discover, share or combine information more efficiently and effortlessly, meeting the initial stepping

stone towards smart applications. The central aim of Web 3.0 technology is to support the users of web to add information in manners so that computers can comprehend, process and trade. These developments in the Web technology would allow Web application to carry out a variety of tedious jobs such as collating information from mixed sources and efficiently support users to explore related information as per their needs. It facilitates the data to be connected from a source to any other source and to be understood by the computers in order to perform gradually more sophisticated jobs on our behalf. The Semantic Web is a net of information connected such a manner that can easy to process by machines, on a worldwide scale. We could imagine it as being an proficient way of showing the data as a globally linked database or on the World Wide Web.

Tim Berners-Lee, who is the inventor of the World Wide Web, HTTP, HTML and URIs, was first thought up about the semantic web. A dedicated team of people at the World Wide Web Consortium is operational to advance, expand and regulate the system, and a lot of languages, tools, publications; and so on, have by now been developed. Though, Semantic Web technologies are yet in their initial stage, and although the prospect of the project in common appears to be bright, there seems to be slight compromise about the characteristics and likely direction the early Semantic Web.

Semantic Web is usually developed on the syntaxes which utilize Uniform Resource Identifiers (URIs) to signify data, generally in triples based structures: that is several triples of URI data that could be stored in the databases, or interchanged on the World Wide Web by means of a set of exacting syntaxes

designed particularly for the assignment. These syntaxes are known as "Resource Description Framework" syntaxes (RDF).

4.6.3.1 URI (UNIFORM RESOURCE IDENTIFIER) AND UNICODE

A Uniform Resource Identifier (URI) is merely a Web identifier similar to the strings starting with "ftp:" or "http:" that we frequently come across on the World Wide Web. Anybody can make a URI, and the possession of them is visibly delegated, so they figure a perfect base technology with which to develop a global Web on the top of. Actually, the World Wide Web is such kind of thing: anything that has a Uniform Resource Identifier (URI) can be considered as "on the Web".

4.6.3.2 RDF-RESOURCE DESCRIPTION FRAMEWORK

The Resource Description Framework (RDF) is a standard model for data exchange on the World Wide Web. The RDF has characteristics that support data merging even if the original schemas vary, and it particularly supports the development of schemas over time with no requirement of all the data consumers to be altered.

The RDF extends the connecting structure of the World Wide Web to employ URIs to define the relationship among things and the two ends of the link (this is generally referred to as a “triple”). By means of this simple model, it facilitates structured and semi-structured data to be integrated, uncovered, and distributed across the diverse applications.

This connecting structure makes a labeled, directed graph, where the edges represent the defined link among two resources, given by the graph nodes. The

above discussed graph view is the easiest probable mental model for the RDF and is frequently utilized in easy to follow and understand the visual explanations.

4.6.3.3 PURPOSE

The major goal of Web 3.0 is driving the development of existing Web by enabling users to discover, distribute, and integrate information without difficulty. Humans are able of utilizing the Web to perform jobs like locating the Estonian translation for "twelve months", reserving a library book, and locating for the minimum price for a DVD. Though, machines can’t complete all of these tasks with no human direction, as web pages are developed to be read by humans, not equipments. The semantic web is an idea of information that can be eagerly interpreted by machines, so that machines can execute more of the tedious jobs involved in locating, integrating, and acting upon the information on web.

Semantic Web, as initially envisioned, is a system that facilitates machines to "recognize" and react to complex requests by humans based on their sense. This kind of "understanding" requires that the related information sources be semantically ordered. Several view this as a mixture of semantic web and artificial intelligence (AI). The semantic web will educate the computer about what the data means, and this will grow into artificial intelligence that can use that information.

4.7 CONCLUSION

This chapter gives a brief overview of the various technologies such as Activity Theory, Multi Agent Systems and Semantic Web that will be applied later in developing an e-Learning framework.

CHAPTER 5

DEVELOPMENT OF MULTI AGENT ACTIVITY THEORY e-LEARNING (MATe-L) FRAMEWORK

5.1 INTRODUCTION

The objective of this chapter is to bridge the gap between the logical framework and the existing methodologies of learning by making use of Activity Theory to fulfill the need for a more extensive unit of analysis for participation in eLearning studies with appropriate and effective research methods.

As defined by Rosenberg [99] "e-Learning is related to the use of Internet and Communication Technologies to provide a solution to a wide range of applications that will increase the knowledge and performance of the learner.". If e-Learning could be blended with instructor led training, then it could provide very remarkable impact in education particularly in areas where a large population however if both the methods are blended together then it could provide some very effective impact in education particularly in India where 70% of the population belongs to rural areas. There are certain issues with traditional learning that have been discussed in the previous chapters due to which the focus has been diverted to online learning. Some of the prominent issues can be summarized as follows:

Firstly, in traditional learning the tutors can impart knowledge to all the learners equally at the same rate. Secondly, there is lack of awareness about the recent

advancements and the latest technologies that have come up in a particular area. Lastly it cannot provide ubiquitous information. Although it is true that e-Learning systems have a large number of advantages but still there are certain key areas where these systems are not at all successful. For instance, if we consider the case of e-Learning of I.C.S.E Board for students of a particular class say X in "Science" subject. The course material should be so designed so that it first checks whether the student has the preliminary knowledge that is required for Class X. Then, the second consideration is that if the content changes then would the content be updated on the Website with pro-activeness in the technology and software. These questions rather problems led to the development of a model to overcome the aforesaid drawbacks using Activity Theory and Multi Agent Systems.

"Activity Theory is a hypothetical framework for the study of the various forms of human activities such as the development process, in a manner that it interlinks the individual and social levels simultaneously". Hence, Activity Theory is dedicated for comprehending both the individual and communal perspectives of human activities from a social and historical point of view. Activity Theory originated from Vygotsky's [61] concept of tool mediation and Leontev's view of Activity [70]. According to Vygotsky, human beings interaction with the surroundings indirectly and this interaction is mediated through the use of tools and signs. We have extended the concept of Engestrom [68] model known as "Activity Triangle Model" which incorporates various components like: Subject, Community, Object

with the various mediators of the human activity such as Tools, Rules and Division of Labor in e-Learning.

The ‘object’ component of Activity Triangle Model displays the decisive character of the human task, which permits the individuals to keep control on their own motives and conduct when performing this activity.

The ‘subject’ component of the Activity Theory model represents both the individual and communal nature of the activity with the aid of various tools in organisational circumstances in order to accomplish the desired motives. Tools mediate the relationship between the subject and the object or we can say, the objective.

The ‘tools’ in the activity model highlight the mediational aspects of the human activity with the help of either physical or psychological tools. Physical tools are those that are used in handling or manipulating the objects. Therefore they enhance the human abilities to attain the aimed goals and to satisfy the objectives. Psychological tools are useful in influencing the behavior in one way or another.

Another component of Activity Theory referred to as the ‘Community’ is used for representing the stakeholders of a particular task. It represents a group of people who contribute to the same objective of an activity. The community component analyses the activity being investigated in either the social or the cultural context of the situation in which the subject is being operated.

The ‘Rules’ in Activity Theory model highlight that there are certain rules and regulations that need to be observed within a community of actors. These rules in one way or the other affect the process by means of which the activity is carried

out. These rules can be either explicit, or implicit. For instance, cultural norms must be in place within a particular community. This component of the Activity Triangle model is also helpful in establishing the conditions and the environmental influences in which the activity takes place.

The “Division of Labor” element tells how the responsibilities and variations in job roles are distributed amongst the subjects involved in carrying out a particular activity inside a community.

Activity System consists of a number of small activities that are inter linked and integrated because of a common objective upon which the activity is targeted. As a consequence of these connections, certain disorder or contradictions occur either within each activity or between the sub activities that could influence the conversion of the collective activity system. The term ‘contradictions’ is applied in Activity Theory to denote the misfits, conflicts, problems or breakdowns, that take place in an Activity System or the human activities being observed. The concept of Activity Theory has been linked with Multi Agent Systems to develop an e-Learning framework. An agent can be considered as an entity that perceives its surroundings through various sensors and then acts upon the environment through effectors. The Agent based modeling breaks through the mono structure and mono angle view of the traditional modeling method. In the Agent based method, the agent involved mainly is autonomous agent. It can perform an intelligent planning and controlling of systems which can react dynamically and automatically. The development of agent and Multi Agent technology brings new ideas to software modeling. The method of Agent based modeling provides a new idea to the

simulation of complex systems. In such method, the agent oriented analysis of the system should be done first and then designing the Agent. The growth of ubiquitous computing has led to the development of heterogeneous and evolutionary computing. The linking with Activity Theory is being achieved on three grounds as stated by Andrea Omicini et al [100]:

- **Co-construction:** Agents understand and reason about the social objective (goals) of the MAS.
- **Co-operation:** Agents design and define the co-ordination artifacts.
- **Co-ordination:** Agents exploit the co-ordination artifacts and then the activities to manage interdependencies and interactions.

5.2 OPERATIONALISING ACTIVITY THEORY AND MULTI AGENT SYSTEMS

In order to apply Activity Theory to e-Learning system using Multi-Agent system we extend the work of Paolo Giorgini, Jorg P.Muller, James Odell [101] on converting it into object oriented framework.

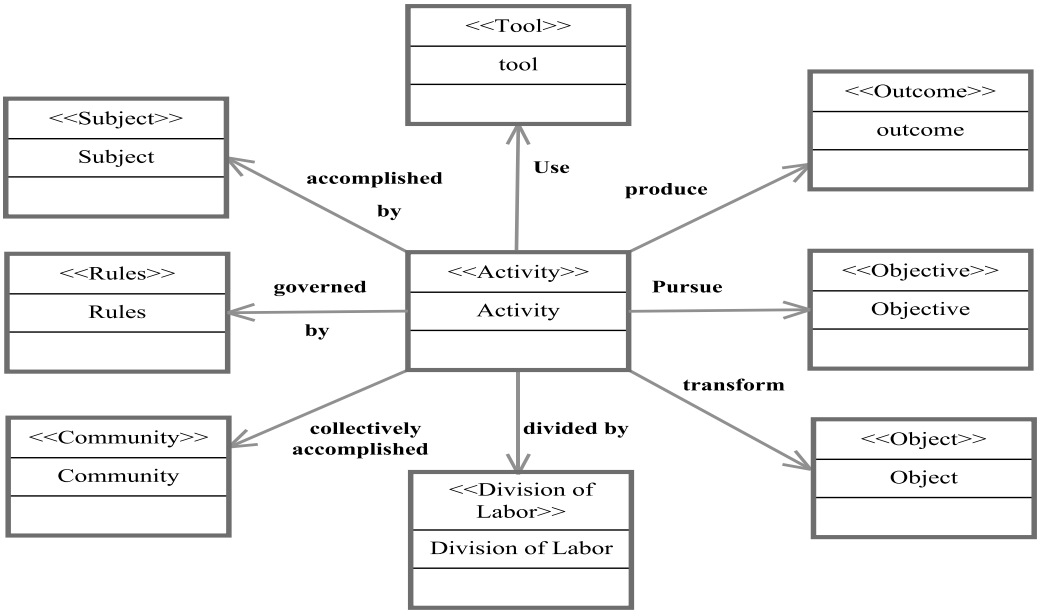

Fig 5.1: Object Oriented Activity Theory Model Using OPEN Framework

Fig 5.1 represents an object oriented Activity Theory model using OPEN framework.

An "object" according to Kutti [81] can be any element, and it can be less tangible or totally tangible till the time it can be shared for updation and changes by the persons involved in the activity. The principle of mediation plays a central role in the AT. An activity comprises of various artifacts such as tools, symbols, events, equipment, resources, laws, types of work, or organizations. These artifacts have a mediating role in the sense that the relations between the elements of an activity are not directed, instead mediated. Tools shape the way human beings interact with their context. A tool could be anything that is used in the transformation process of the object. It may include both material tools and tools for thinking. Rules (e.g. laws, social conventions, or norms) determine the relationship between the subject and the community whereas the relation between object and community is

mediated by the division of labor that decides how the activity is to be distributed among the individuals of the community. The division of labor establishes the role that each individual in the community has in the activity, the power that each community has, and the tasks that each will be held responsible for.

5.3 e-LEARNING FRAMEWORK (MATe-L) USING MULTI AGENT SYSTEMS AND ACTIVITY THEORY

The mapping between Activity Theory and MAS Notations [102,103] can be mapped with e-Learning Multi Agent system as shown as in Table 5.1.

TABLE 5.1. MAPPING BETWEEN MAS NOTATIONS, ACTIVITY THEORY AND E-LEARNING SYSTEMS

SIMULATION MODEL VARIABLE	MAS NOTATION	E-LEARNING
Activity	Task	To perform e-Learning
Subject	Task, Interaction	Indian Students
Object	Resource	e-Learning Modalities
Outcome	Response, Action	Learning effectiveness / impact
Objective	Perception	Ubiquitous learning environment
Tool	Interacting Components	Adaptive e-Learning tool MATE-L
Community	Environment	e-Learning Community
Rules	Algorithms	Learning Management System
Division of Labor	Co-ordinating algorithm, Agent Modeling	Various Socialized Tutors

Based on the above concept we develop a tool MATe-L which could manage all the e-Learning activities. The concept is realized using AUML. The tool MATe-L supports all the functionalities and relationships of Activity Theory in conjunction with e-Learning using Agent UML. The basic diagram of Object Oriented AT

framework developed by Paolo Giorgini, Jorg P. Muller, James Odell [101] is extended for this purpose in Fig 5.2. An extension of UML known as Agent UML (AUML) is used to synthesize an evolving concern for agent based modeling representations.

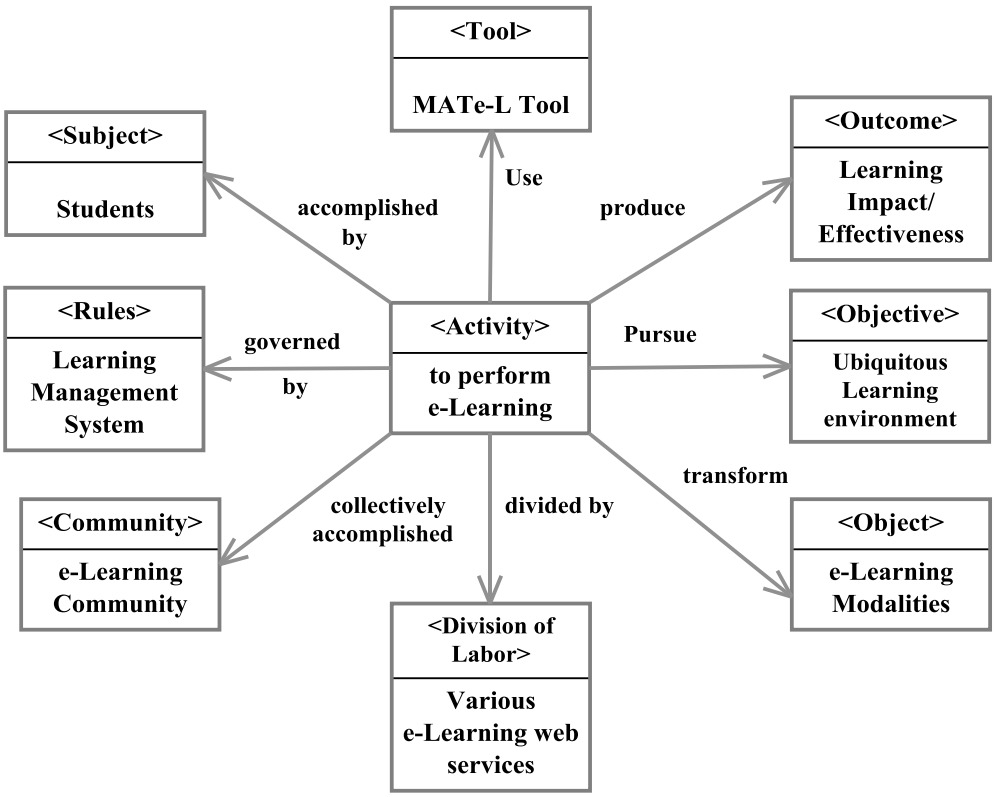

Fig 5.2. Object Oriented Activity Theory Model using MATe-L

The purpose of Agent UML is to offer to develop a notation that it is used to analyze, design and implement Multi Agent System. In MATe-L we have tried to integrate AUML and e-Learning Notations. The MATe-L tool support developed in [104] provides the features like Sequence Diagram and Activity Diagram. The upper window represents the detail diagram of Sequence/ Activity as shown in the Fig 5.3. The second window represents the Protocol which is automatically

generating FiPA of the above diagram. The main advantage of developing such a tool is the type of Message Delivery. Agent UML represents Nested and Interleaved Protocols. Message interactions are communicated asynchronously. The agent role waits till an acknowledgement message is received. During this waiting time nothing else can be processed. The other option is Agent Class Diagram which currently meets the FiPA Norms which contain several elements like:

- Agent Name: It is different from class. The stereotype <<Agent>> prefixes agent name. The information supplied with the agent name are: Instance, Role and Class.
- State Description: It is similar to the attributes in the class diagram except that in this we have well formed formula denoted by wff for all types of the logical description of the states.
- Actions: There are two types of actions that an agent can be related to: pro-active actions denoted by <<pro-active>> that are triggered by the agent. The second type of action is <<reactive>> that are triggered when we receive some message from other agent.
- Methods: Methods are defined like operations in UML. An operation is basically the implementation of a service since that can be requested from any object of the class to effect the behavior.
- Capabilities, Service Description: It is used to define the capabilities of the agents. Service description is linked with UML interface.

- Agent Head Automata: It is used to define the behavior of an Agent Head. Agents are composed of three parts: Communicator, Head and Body.

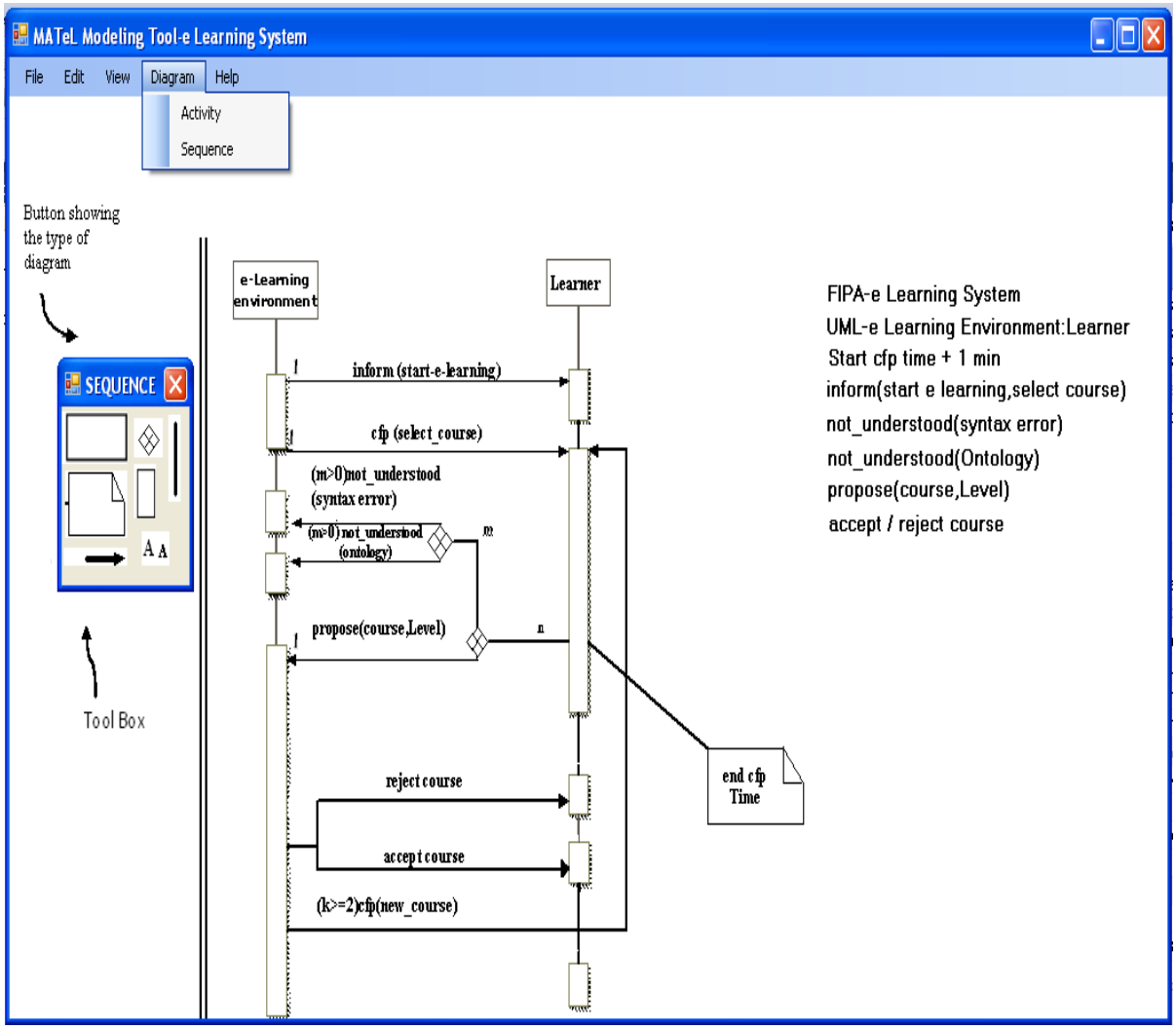

Fig 5.3. MATe-L Tool

In AUML the general format for defining the instances and roles is:

< instance-1……..instance-n> and <role-1……..role-n>. A class denotes a distinguished set of Agent instances like instance-1…….instance-n satisfying the roles like role-1…….role-n.

The state description is represented in BDI semantics; one can define for instance type named: beliefs, desires, intentions and goals. Action too has two categories: pro-active actions <<pro-active>> and reactive actions << reactive>> that are initiated by the Agent itself using a timer. Methods are similar to the operations of UML, it is an abstraction of something you can do to an object and that is shared by all the objects of that class: Agent Head Automata. Agents are composed of three parts: Communicator, Head and Body that are standardized by FiPA.

5.4 PROPOSED ALGORITHMS FOR COURSE ALLOCATION AND LEARNING

In this section we have proposed two algorithms. The first one is for allocating the right course to the right student based on his/her preferences and existing knowledge. The second algorithm is for learning that is whether the student has learnt the allocated course**.**

5.4.1 RIGHT COURSE ALLOCATION AND PACE SETTING ALGORITHM

Active user Session

Matching of Learning Phase

Recommendation set s = (Course, Pre- requisites)

Prerequisites=(C_i , P_i)

Initial Learner Set i={C_i ,$Skill\_Set_{ij}$, $Grade_{ij}$}

Threshold σ=0.5

Ontology w={C_i,P_i,$Skill\_Set_{ij,}Grade_{ij}$}

Ontology w={w_1, w_2,w_3,w_4,-------,w_n}

For each user S_i having Skill_Set w_3

```
{
        if(w2= = w3 && w4>=0.5)
        {
                Assign_Course(w1);
        }
        else
        {
                if(w4 <0.5 && w2= =w3)
                        then Request_for_Lower_Course ( );
                else if (w2 != w3)
                        Select_New_Course ( );
        }
}
```

5.4.2 LEARNING ALGORITHM AFTER COURSE ALLOCATION

```
begin
        Session=Session_Id
        begin (1)
        t=0;
        Initialize_Course_Object (t);
        Evaluate_ Course_ Object (t);
        No_ of_ Modules_ in_ Course_ Object=n;
        while (n >=0) do
        begin (2)
                t=t+1;
                Select (New_ Course_ Module) from (Remaining_Course_Module);
```

Evaluate (New_ Course_ Module);

end (2);

end (1);

end;

5.5 CONCLUSION

This chapter highlights the use of Activity Theory with Multi-Agent System for e-Learning. We have developed a tool MATe-L which helps in developing a framework for e-Learning. The use of Agent UML helps in software modeling of the e-Learning components like Learning Management System, Learning Content Management and Computer Supported Collaborative Learning. The use of Activity Theory enhances the modeling framework as it gives a clear picture of the students psychology which can be modeled into the framework. We will be extending it with Web 3.0 interface in the next chapter.

CHAPTER 6

AN ADAPTIVE NORMATIVE MULTI-AGENT SYSTEM USING WEB 3.0 FOR e-LEARNING

6.1 INTRODUCTION

This chapter explains the development of the e-Learning framework by assimilating the concepts of Activity Theory, Norms, Multi Agent Systems and Semantic Web to provide right kind of knowledge to the right student. As discussed in the previous chapters, Internet based learning has become a substitute way out for the traditional learning. Hence, it has become necessary to manage the learning contents in the e-Learning atmosphere in order to deliver it to the learners on the basis of their requirements and preferences. The application of Semantic Web Services helps in developing a machine comprehendible and a common logical framework which can collect and share concepts from different web service resources to fulfil a particular research objective in question. There are different SWS composition techniques that have been developed for different purposes and objectives. Basically, there are two Agents that have been considered- one is the Service Requester Agent or we can consider him as the student in our e-Learning framework. The next agent is the Service Provider Agent or the tutor in the e-Learning System. The anticipated framework has shifted the

focus of the learning process from the tutor centered to learner-centered [105] approach. This migration will give the learners a self paced learning process in which they have more opportunity to select their study material and learn according to their own spirit. The learners can select the learning material based on their preferences and interests. Learning thus becomes a self motivated and self paced learning process rather than an imposed method of learning. As many of the e-Learning systems exhibit their contents statically, they have a very small range of possibilities [106]. On the contrary, due to the huge data size of the web and inadequate amount of semantics of the HTML pages [107], the search for the study content has become a very complex task in terms of both time and effort. The main objective of Web based learning is to make its content broadly available, retrievable and reusable [108] for its users. The semantic description must also be stored in order to migrate from human accessible to machine accessible [109]. The search results need to be improved upon and this is only possible if the content is searched for and queried upon semantically to facilitate the growth of web technologies. The organization of the huge quantity of data involves efforts to supervise it and arrange it in a manner that it is easily accessible. For this the contents need to be arranged in an orderly manner either by the use of indexes or by employing some other method for fast retrieval of data [110]. A convincing approach to e-Learning that ensures machine processing and interchangeability is the Semantic Web. Semantic Web aims to introduce the concept of metadata, which means data about data in order to describe the Web resources to create environments that are able to perform automated processing of the data available

on the Web by means of agents-may be human agents programmable agents [111]. The backbone of Semantic Web is the ontology description. Ontology is basically an illustration of shared concepts that are relevant to a particular domain. It gives a representation of the relationships that prevail between the different concepts that are interlinked to each other. Ontology represents a relation of taxonomy among the various classes, properties of data types, a detailed description of the elements of the class, properties of the objects, relationship between the elements of the class, instances of the class and the property of those instances. The repository of the data type properties and properties of the object is referred to as a class. An ontology can be expressed in any Description Logic such as the Web Ontology Language-Description Logic OWL-DL [112]. It provides interoperability among the client agents and the services with the minimum interference of a human agent in order to fulfil an assigned task. Web services have the potential to enable the organization to create logic driven by a chain of information and knowledge value in the digital economy based on the content [113]. A Multi Agent System is typically a system that is composed of a collection of agents that can potentially communicate with each [114]. The MAS model has been employed for enhancements in different areas such as e-commerce and e-government. In [115] the authors have argued on the selection of a seller agent based on competitive arbitration factor in B2C e-commerce. In [116] the authors have presented the fund collection model in educational institutes and how its monitoring is done using MAS. Zouhair et. al [117] have adopted the Multi Agent System and dynamic case based reasoning to improve the learning process by retrieving the previous

experiences that are similar to learners' trace. Many researchers are actively engaged in the direction of addressing the problem of search of and access to the learning materials recourses on the web. Emina [109] reveals certain specifics that need to be kept in mind while generating a consistent metadata for the learning contents. Ontology is also used to construct the content for learning in online learning systems to generate the learning path [118]. Gladum et al. [114] presents a Semantic Web based Multi Agent System prototype for e-Learning system to control the students' acquired knowledge. LT4EL project provides a semantic search for the learning content in the domain ontology [119]. Pandey et al. [120] have used different intelligent agents in e-Learning system to gather the requirements from the students and fulfil them.

In this chapter we will propose an e-Learning framework that takes the advantage of Semantic Web Services and Multi Agent System to allow learners to choose appropriate learning materials from different resources. We have also amalgamated the concept of Norms in developing the framework.

6.2 INTRODUCTION TO NORMS

Norms play a vital role in assessing the actions of the individuals in human culture [121]. Norms are the rules that are developed by the society to govern the recommendation or prohibition of certain behavior or act. Norms help in improving the co-operation and co-ordination among individuals. It can be said that Norms are the outlooks of an agent about the behavior of the rest of the agents in the vicinity. Human society follows many rules or Norms, such as the Social Norms, Moral Norms and Legal Norms. Norms have become so prevelan in

different cultures, that it is not surprising that it is an active area of research in a variety of areas.

6.2.1 NORMS IN HUMAN SOCIETIES

Several definitions exist for Norms due to their multi-disciplinary nature. Habermas [122], a very distinguished theorist, recognized the actions governed by norms as one of the four patterns actions that exist in the human behavior. A widely accepted definition of social norm is that it fulfills a generalised expectation of behavior. An expectation of behavior is generalized if each member of a social group expects all other members to act in a certain way in a given situation. Ullmann-Margalit [123] defines a social norm as a standard guide for the conduct or action which is generally complied with by the members of the society. Norms are the consequence of complicated patterns of actions of a group of people over a certain period of time. According to Coleman [124] a norm concerning a specific action exists when there exists a right to control that action socially and that right is held by others and not by the actor. Elster makes the following observations regarding the social norms [125]: “The norms can be communal if and only if they are mutual between the people and are partly persistent by their agreement and disagreement. The norms are made persistent by various emotions such as the feeling of humiliation, nervousness, repentance and mortification that an individual suffers from after violating them. An individual who is satisfying a norm may also be instigated by optimistic emotions. The common feature of all the above definitions is that an agent behaves in a definite way in a particular situation and the appropriate conduct is dictated by the group. Tuomela [126] has

grouped norms into two categories: social norms and personal norms. Social norms define the behavior of the group and are associated with sanctions. Personal norms are based on the personal beliefs of the individuals. Personal norms are the potential social norms. These norms could become social norms if they were to be observed by other agents and if sanctions were associated with not following the norm. Social norms are further classified into rule norms (r-norms) and social norms (s-norms). Personal norms are categorised into moral norms (m-norms) and prudential norms (p-norms). Rule based norms are decided by an authority on the basis of a contract between the members. Social norms are based on the mutual belief and they are imposed in a large group such as the entire society. Members of a society expect that a social norm be followed by other members of the society. Moral norms are the demand to an individuals' conscience. Prudential norms are based on prudence. The society members may be punished or even detested in some cases [127] when they violate the societal norms. There are various reasons for norm observance such as:

1. Terror of authority or power [128].
2. Coherent appeal of the norms[121,129].
3. Feelings such as embarrassment, remorse and humiliation that arise due to non-adherence [125].
4. Agreement to follow the crowd [130].

The social norms are generally comprised of the following three aspects based on the definitions given by various researchers:

- **Expectation of the behavior based on the norm:** It means that a certain kind of behavior is expected on the part of an agent or actor by others present in the society under a given circumstance.
- **Norm enforcement mechanism:** The agent may be subjected to sanction if it does not follow the norm in the environment. The sanction can be financial or physical penalty in the real world that could arise emotions like humility, guilt etc or direct loss of utility. Another means of sanction could include agents not wanting to interact with the other agent that violated the norm or trying to decrease of its reputation score. Agents that follow the norm might be rewarded.
- **Norm spreading mechanism:** It includes the advice from dominant leaders and entrepreneurs, and the cultural and evolutionary influences. For an external observer, agents identifying and adopting norms through learning mechanisms such as imitation may also appear to spread norms in agent societies.

6.3 NORM LIFE CYCLE

The various stages included in the Norm Cycle are: Norm Creation, Norm Identification, Norm Spreading, Norm Enforcement and Norm Emergence.

6.3.1 NORM CREATION

Norm Creation is the first phase of the life-cycle model of a Norm. The norms in multi-agent systems are created by either one of the following three approaches:

- Designer norms (off-line design) [131],
- A norm-leader specifies norms [132,133],

- A norm-entrepreneur considers that a norm is good for the society [134].

In the off-line design approach, offline designing of the norms is done, and then they are hard-wired into the agents. This approach has been used by researchers to study the standards that could be beneficial to society as a whole using social simulations. In leadership approach, some powerful agents in the society that can be called as the norm-leaders create a norm. The leadership approach can be based on authoritarian or democratic leadership. These norms are distributed among the follower agents by the leader agent [132,135]. In the entrepreneurship approach for the creation of norms, there might be some norm entrepreneurs who are not necessarily the norm leaders but create a proposed norm. An agent can motivate other agents to follow the norm once it is created by it [134,136].

6.3.2 NORM IDENTIFICATION

After the creation of Norms by any of the above mentioned approaches discussed above the norm has to be spread in the society. However, if the norms have not been explicitly created (i.e. norms are derived based on the interactions between agents), then an agent requires a mechanism to recognize the norms from its environment based on its communications with other agents. In game-theory based empirical works [137,138], agents have a limited number of actions that are available, and they choose the action that maximizes their utility as the norm, based on some learning mechanism such as imitation, machine learning or data-mining.

The second approach to norm identification considers the cognitive capabilities of an agent to deduce what the norms of the society are [139]. In the second approach, one or more intelligent agents in the society may come up with norms based on the deliberative processes that they use [135,139]. Depending upon the observations and the interactions amongst the agents, this approach has the ability to identify the norms of the society. Agents have normative expectations, beliefs and goals. The norms deduced by each agent might be different since they are based on the observations that an agent has made. Hence, based on the inference model creates its own notion of what the norms are.

6.3.3 NORM SPREADING

Norm spreading refers to the circulation of a norm among a group. Once an agent knows what the norm in the society is (i.e. either based on norm creation or identification). There are many mechanisms that help in spreading the norms such as leadership, entrepreneurship, cultural, and evolutionary mechanisms. For an external observer, agents identifying norms through learning mechanisms such as imitation appear to spread norms in agent societies.

6.3.4 NORM ENFORCEMENT

In Norm enforcement, the norm violators are discouraged through some form of sanctioning. An extensively used sanctioning mechanism is punishing the norm violator by means of either financial punishment which reduces the agent's fitness or giving a punishment that invokes emotions such as guilt and embarrassment. Another form of sanctions could be Reputation mechanisms where an agent is black-listed for not observing a norm. The enforcement process helps in sustaining

norms in a society. Enforcement of norms can influence norm spreading. For example, when a powerful leader punishes an agent, others observing this may identify the norm. Hence, the norm can be spread. Norms can also be spread through positive reinforcements such as rewards. According to some of the researchers norm enforcement can be considered as a part of the spreading mechanism [128].

6.3.5 NORM EMERGENCE

It is the fifth phase of the Norm life cycle. A Norm emergence is said to reach a significant amount of threshold in the extent of norm spreading that is we can say that a norm is followed by a substantial portion of an agent society and this fact is realized by most of the agents. For instance, a society could be said to follow a norm of gift exchange at New Year if more than x% of the population follows such a practice. The value of x varies from one society to another and from from one kind of norm to another. The value of x has varied from 35 to 100 across different simulation studies of norms. Emergence can be detected either from a global view of the system or through a local view of an agent (e.g. an agent might only see agents that are one block away on all directions in a grid environment). Spreading of norms with or without enforcement can lead to emergence. Once a norm has emerged, the process can continue till an entrepreneur or a leader comes up with a novel norm that replaces the existing one. The adoption of a norm may decrease in a society due to several reasons. A norm that has emerged may lose its appeal when the purpose it serves does not hold or when there are not enough sanctions or rewards to sustain the norm or when other alternate effective norms

emerge. An external agent will able to observe the norm establishment and de-establishment in the society based on the emergence criterion (i.e. the extent of spread of the norm).

6.4 DEVELOPMENT OF NORMATIVE MULTI AGENT SYSTEMS USING ACTIVITY THEORY FOR e-LEARNING

e-Learning can be considered to be sustainable if it is normative in satisfying the needs of the present and future trends of learning. In this chapter we propose an Activity Theory framework that makes use of the concept of Norms to implement an e-Learning framework that can adapt itself according to the needs of its users. Activity Theory provides an opportunity for the assumptions, standards and values that highlight each system to be made more precise. The expansionist learning is possible due to the debates, consultations and reviews on the topic of concern. That is the learning trend is different from what it would have been if the actors from each perspective remained isolated from the events occurring inside the system. Activity Theory has been proved to be successful in identifying the tensions and contradictions that arise when two different activity systems of face-to-face teaching and e-Learning technologies come into juxtaposition. Vygotsky [61] started the concept of Activity Theory. He established a correlation between psychosomatic activities and societal activities. Later on, Engestrom [68] modified it. The concept of Activity Theory was modified by him in a triangular form which consists of six basic components in the Universe of Discourse. The components comprising the Activity Theory Triangle are: Tools and Signs, Subject, Object, Rules, Community and Division of Labor to generate an outcome of the activity.

As discussed in the previous chapter, tools mediate the relationship between Subject and Object. Similarly, Division of Labor mediates the relationship between the Object and the Community.

Table 6.1. Mwazama's Layerical Classification of Activity Theory

	Determine the	**Task to be performed**
A	Activity of Interest	What is the type of the Activity I am in?
B	Objective of Activity	What is the reason for occurrence of the Activity?
C	Subject of this Activity	Who all are involved in carrying out this Activity?
D	Rules & Regulations	Are there any social norms, rules or guidelines that govern the performance of this Activity?
E	Division of Labor	Which person is responsible for what task when the Activity is in execution?
F	Community	What is the atmosphere in which this Activity is taking place?
G	Outcome	What result is desired after carrying out this Activity?

Mwazama [140] developed an eight step model based on the guidelines given in Table 6.1. On the outline of this model a relationship is developed between the Activity Type and the Linguistic Norms as can be observed in Table 6.2.

Table 6.2. Relationship between Activity Theory and Normative Systems

	Activity Type	**Linguistic Connectivity Norms**
A	Activity of Interest	(performed by)
B	Objective of Activity	(has an)
C	Subject of this Activity	(supported by)
D	Rules & Regulations	(has)
E	Division of Labor	(supported by)
F	Community	(performed by)
G	Outcome	(has an)

Depending upon the above Layerical Classification of Activity Theory, we can develop an Activity System for e-Learning by substituting appropriate e-Learning components for the various constituents of Activity Theory Triangle. For instance, the Subject in Activity Theory corresponds to students and tutors in e-Learning System. The objective in Activity Theory corresponds to the acquisition of knowledge desired by the student. The Rules and Regulations in Activity Theory correspond to the method of assessing the students performance, delivering the learning material, conducting examinations etc.

Similarly, Division of Labor in Activity Theory corresponds to the teachers, learners, system administrators, content developers etc. The Community in Activity Theory corresponds to teachers, learners, text developers, researchers, students etc. In addition to Activity Theory, the Norms concepts are used to define the reactions of the agents in a Multi-Agent System. Norms are a set of rules and

guiding principle. The initiative of incorporating Norms in Multi-Agent is its explicit support with respect to the situation. The components of Activity Theory are linked with Norms and Multi Agent Systems to develop a Normative Multi Agent System (NorMAS). For this firstly, we transform the rules or the linguistic Norms into Activity Theory after the analysis of the framework for the two systems as shown in Table 6.2.

The meta rules of the Normative Systems for e-Learning can be embedded within Activity Theory. The various stages of Norm Life Cycle includes The Creation of Norms, Norms Identification, Norms Spreading, Norms Enforcement and Norm Emergence that are applied to the various components of Activity Theory like Subject, Object, Division of Labor, Objective, Community and Outcome since Activity Theory is classified as a social activity that is carried out wrt the organisation and the community.

Fig 6.1 demonstrates the framework for conversion of Norms into Activity Theory (AT) and then its final linkage with e-Learning activities. The different phases of Norms as stated in [135] provides a mechanism to categorize the simulation based on the work on Norms.

The first phase of Norm life cycle i.e., the Norms Creation can be associated with Activity Theory as the process of initializing an object meaning to say that the object upon which a particular process is to be executed is initialized. In e-Learning it can be considered as identification of the appropriate tutor for the student offering a particular course. It means that the appropriate course must be allocated to the student based on his/her preferences and depending upon the

allocation the expert tutor is allocated to the learner.

Secondly, Identification of Norms is concerned with the method in which we implement the Norms based on the environment in which it will be executed. The Normative Multi Agent System will identify the norms depending upon the situation at that instant of time and then the agent will react accordingly. The "Subject" component of Activity Theory, can be co-related to e-Learning by means of the activity "Structured Course Content" which depends on the object that is the type of the student.

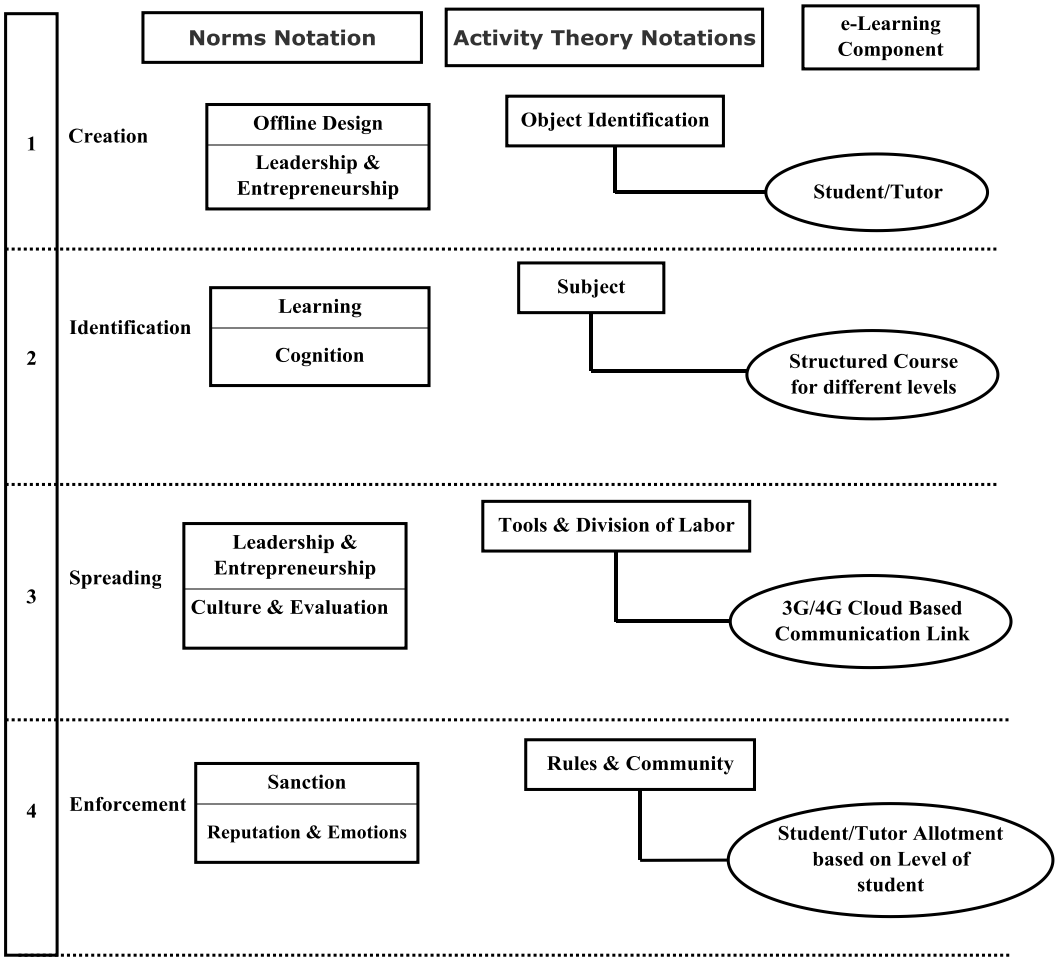

Fig 6.1 A Relationship between NORM-AT and e-Learning [105]

The third phase of Norms life cycle that is the Norm Spreading phase is concerned with the circulation of e-Learning features in the surroundings. The spreading of Norms could be done either by using leadership skills or by means of other evolutionary mechanisms. Spreading can be co-related to Activity Theory in terms of Tools and Division of Labor by means of which we can disseminate the object.

At last, Norms Enforcement is the process of enforcing the norms that is the rules with the aid of some kind retribution to the person who violates the Norms. The Norms can be co-related to the "Rules" component of Activity Theory. In e-Learning it can be considered as the setting up the learning standards based on the type of the student.

The aforesaid correlation between Activity Theory and Norms with respect to e-Learning are applied for rule based learning using Web 3.0. The developed framework is then verified using Hypothesis Testing.

6.5 WEB 3.0 E-LEARNING FRAMEWORK

Due to an efficient engine design the Semantic Web or Web 3.0 is able to organize the huge amount of information available on the Web in a more comprehensive way than Google can do. The main feature of Semantic Web is that it makes the data machine comprehendible rather than depending upon the human for analysis and comprehension of data. Declarative Ontology language like OWL (Web Ontology Language) is used in Semantic Web for producing a domain specific ontology that can be used by the machines to analyze the informative and derive new conclusions from it instead of just comparing it with the keywords entered by the user. For this we first design an ontology diagram for e-Learning using Web

3.0. It is used for the definition of the terms and the relationships that will be used in the e-Learning domain. Axioms and constraints are used for the management and manipulation of terminology used in the specified domain. The different intelligent systems are integrated at various knowledge levels by means of the ontology design and hence sharing of knowledge becomes much more easier [141] and is not dependent on a particular infrastructure. Ontologies can be considered as a basis for the developing a repository of shared and reusable knowledge

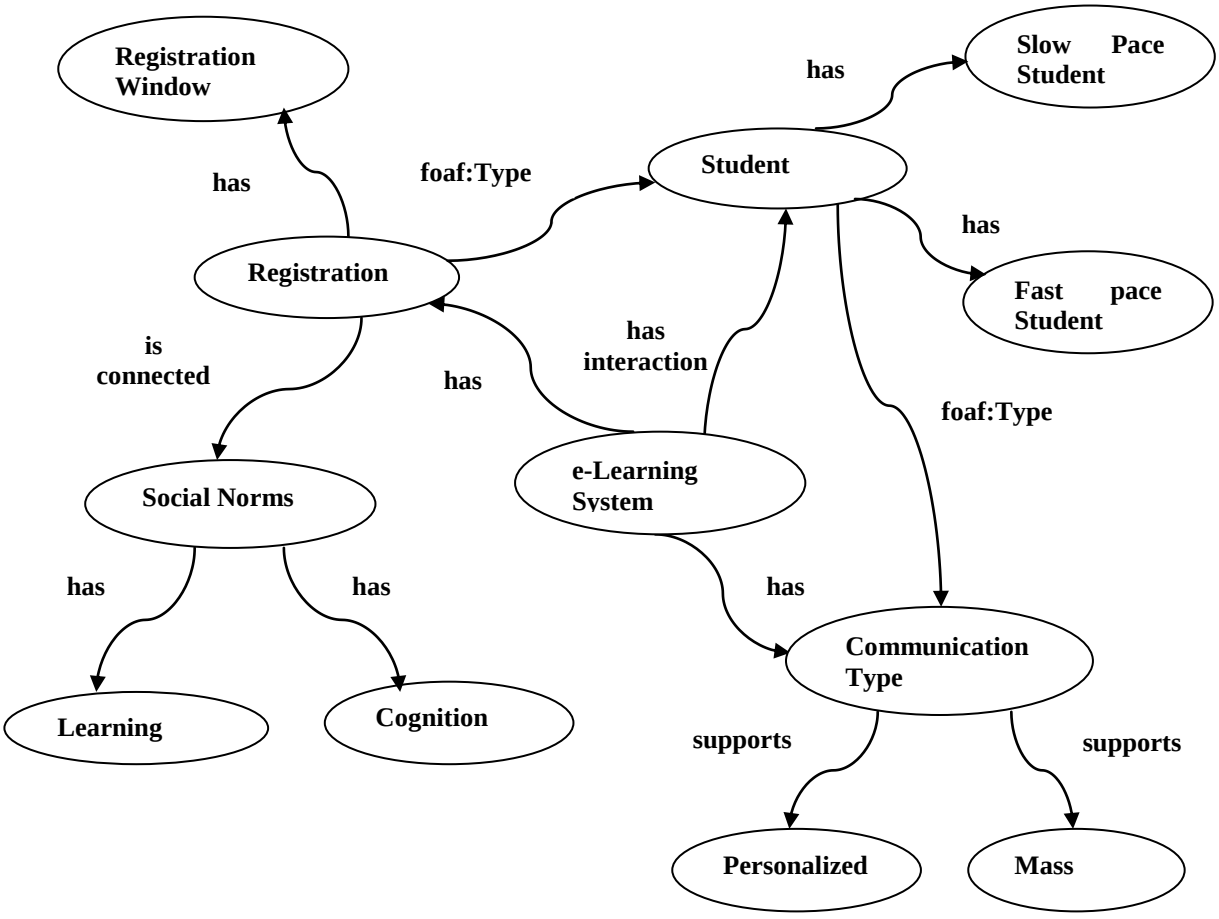

Fig 6.2. Ontology Framework for e-Learning Norms

The ontological framework for e-Learning Norms is represented above in Fig 6.2. It depicts the flow of the various entities involved in the e-Learning systems.

The e-Learning System interacts with the student by means of Registration. The Registration process has a Registration Window by means of which it registers a student who is interested for enrolling in a particular e-Learning course. During registration all the details relevant for enrollment, his current education details and current course preferences are entered by the student. The registration process is subject to Social Norms. If the norms have been created explicitly in the society then the norm may spread in the society. However, if the norm has not been explicitly created then an agent has to identify norms from its environment based on the interactions with the other agents. Agents have a limited number of actions that are available and they select the action that maximizes their utility as the norm, based on some learning mechanism such as imitation, machine learning or data mining. Another approach for norm identification considers the cognitive capabilities of an agent to deduce what the norms of the society are [142]. This method enables the agents to be familiar with what the rules of the society are based on the interpretation of communications among the various agents. Agents have normative expectations, beliefs and goals. The e-Learning system can communicate with the student in two modes: Personalized Communication or Mass Communication. For a slow pace student the communication mode can be personalized in which there is synchronous interaction between the learner and the tutor. A dedicated tutor expert is allotted to each student based on his course. However, for a fast pace student communication mode could be mass in which

case a tutor would be responsible for handling a group of students enrolled in a similar course. Hence, there could be interactions between the student and the tutor and among the various students themselves.

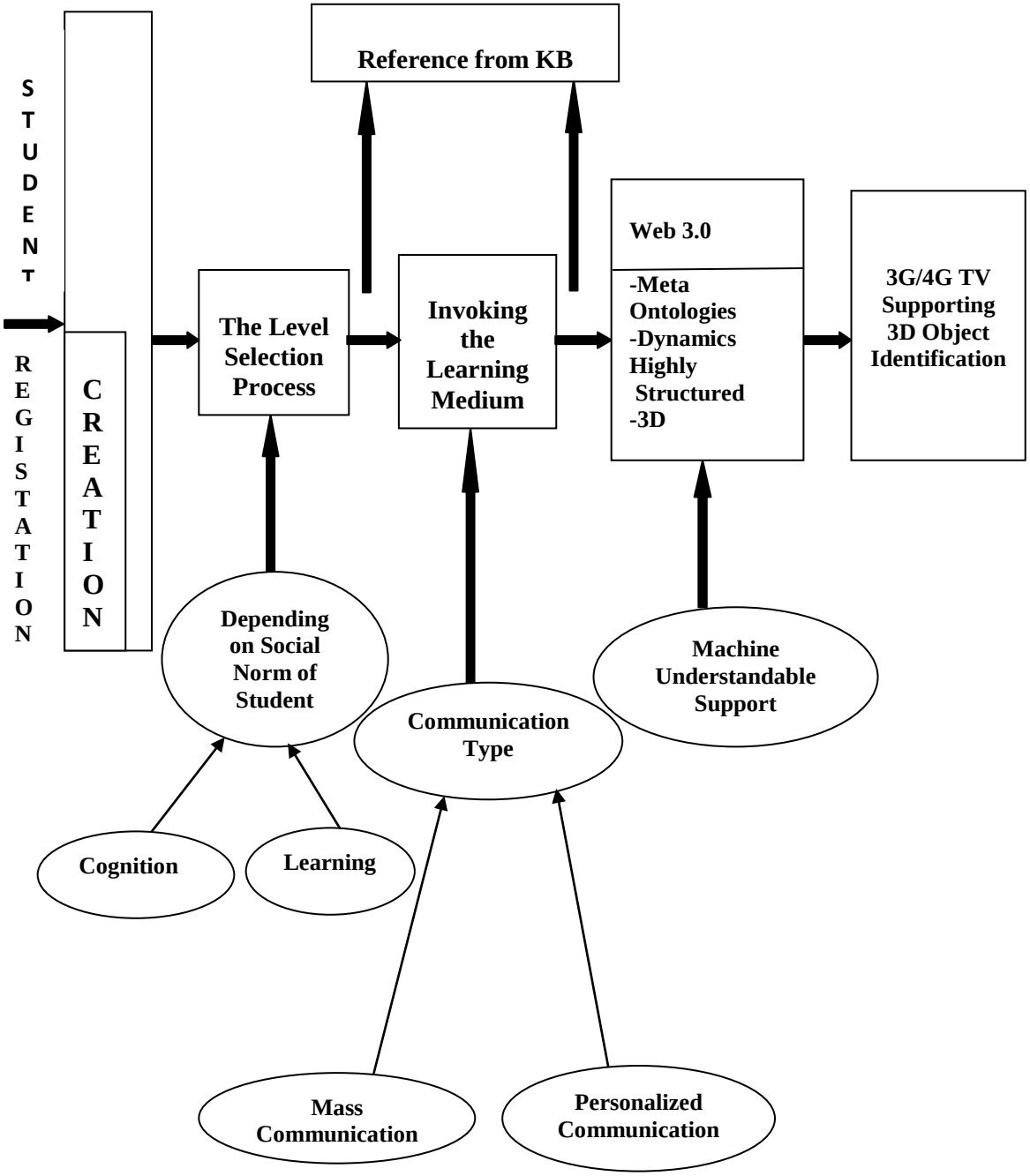

Fig 6.3. Web 3.0 support to e-Learning using 4G TV with 3D

Semantic web provides an environment that can range from individual to mass, and from slow rate of interpreting to fast rate of interpretation and finally a 4G support that makes use of a Smart Television Set. Fig. 6.3 shows the co-ordination set for the process of registering a student for a certain course till the final allocation of the course followed by the delivery of the course with the intermediaries as the Level Selection Process and the Learning Medium.

A user will first register for a particular course of his interest and then depending upon the request the pre-requisite will be intelligently tested by the machine. If the user meets the pre-requisites he will be allotted the course. This is concerned with single user mode only. In the case of group based learning mode, the pace of learning will be decided by the tutor and there will be no validation for the level of learning and its pace. Fig 6.4 below represents the final e-Learning framework incorporating the above concepts using Web 3.0.

The concept of cloud computing provides an appropriate pool of computing resources with its dynamic scalability and usage of virtualized resources as a service through the Internet. e-Learning systems usually require many hardware and software resources and hence there exists many educational institutions that cannot afford such investments, and hence cloud computing is the best solution for them.

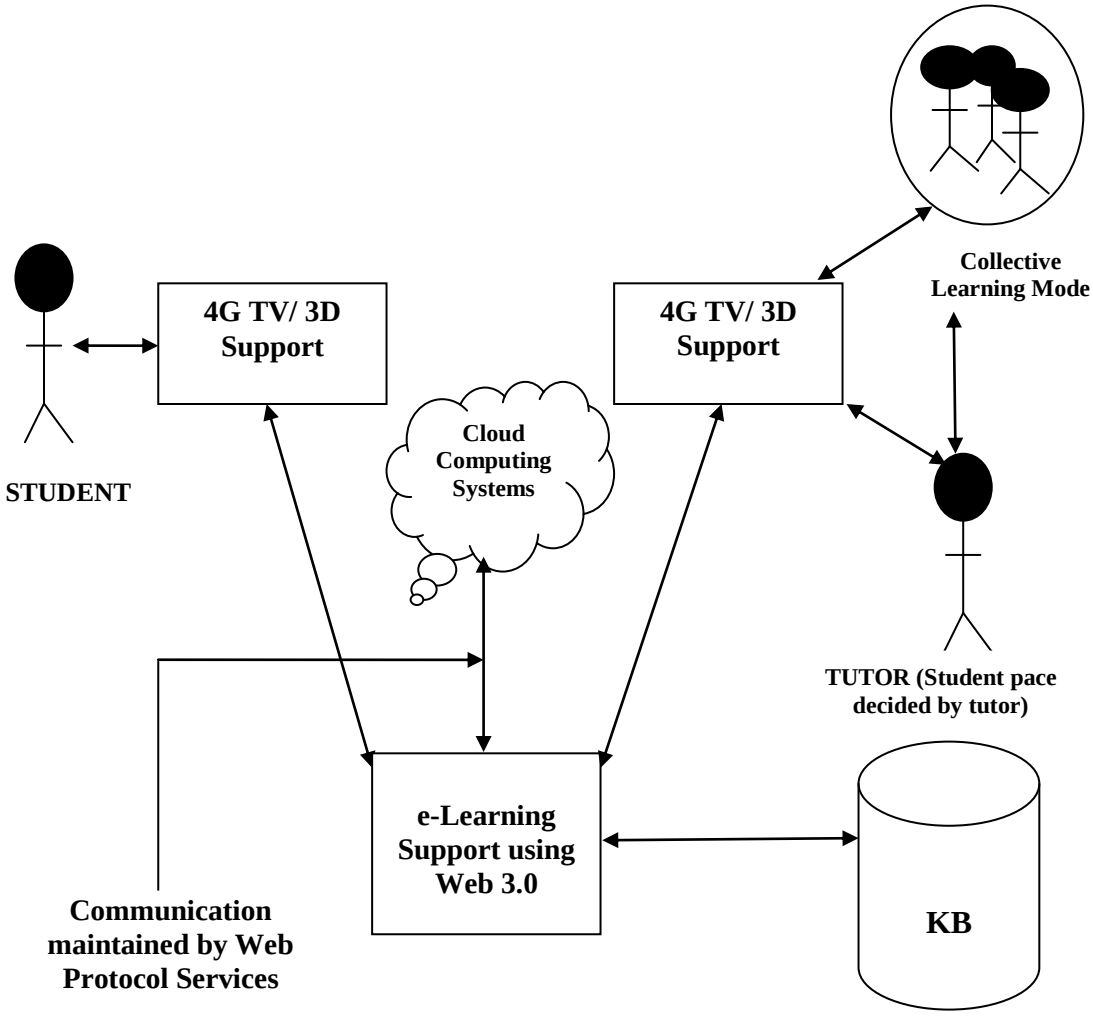

Fig 6.4. e-Learning Framework using Web 3.0

The resources could be network servers, applications, platforms, infrastructure segments and services. Cloud computing deliver services autonomously based on demand and provides sufficient network access, data resource environment and effectual flexibility. This technology is used for more efficient and cost effective computing by centralizing storage, memory, computing capacity of PC's and servers. The benefits of cloud computing can support education institutions to resolve some of the common challenges such as cost reduction, quick and effective communication, security, privacy, flexibility and accessibility.

6.6 CONCLUSION

The chapter contributes in proposing an e-Learning framework that makes use of agents based on the Semantic Web. A prominent feature that distinguishes it from the existing e-Learning systems is the application of Normative Multi Agent System along with the Activity Theory and supported by Web 3.0. The utilization of Semantic Web makes the system simple to use for both the tutors as well as the learners since they can easily retrieve the information that is most relevant for them based on their query. The key purpose of the framework is to make the e-Learning system that can be customized as per individuals preferences and requirements so that anyone and everyone can make the best use of it.

CHAPTER 7

VERIFICATION OF THE e-LEARNING FRAMEWORK USING HYPOTHESIS TESTING

7.1 INTRODUCTION

Hypothesis testing is a process of making a choice between several competing hypotheses about probability distribution on the basis of the observed data distribution. Hypothesis Testing is a very prominently used method of verification that is used in statistics. In statistical hypothesis testing we make a statistical inference based on the data that has been gathered from a research or survey carried out. If the occurrence of the result is predicted as unlikely according to the pre-calculated threshold probability also referred to the significance level, then the result is called as statistically significant in statistics. Ronald Fisher [143] was the person who initiated the concept of "test of significance". The tests of significance are used to determine that which outcomes of a research will direct to a denial for a pre-specified significance level of the null hypothesis. This provides contribution in deciding whether the results contain sufficient information or not in order to cast disbelief on predictable insight, to establish the null hypothesis, considering the fact that the usual perception has been applied. The critical region of the hypothesis test is defined to be the collection of all the outcomes that will cause the null hypothesis to be redundant in comparison to the alternative hypothesis.

Hypothesis testing is referred to as statistical or confirmatory data analysis as it has pre-defined hypotheses, in disparity to the exploratory method of data analysis, that might not have pre-specified hypotheses. One of the vital part of the statistical inference is the setting up of the hypothesis and then testing the hypothesis. For formulating such a test, some theory has to be put forward and that theory may be supposed to be accurate or it can be used as a source for the argument and then proved later. For example, claiming that a particular medicine for a particular ailment is better than the existing one.

7.2 STEPS OF HYPOTHESIS TESTING

Hypothesis testing is carried out in following steps [144,145]:

Step 1: Identify the hypothesis or claim that needs to be proved. For instance, we want to determine that majority of students prefer e-Learning in comparison to traditional learning.

Step 2: Decide upon the criterion on the basis of which we will decide whether the hypothesis being claimed upon is true or false. In a way, it can be said that in this step we define the threshold value for deciding the truth or falsity of the hypothesis.

Step 3: The third step involves selecting a sample population and measuring the sample mean.

Step 4: In the last step, we compare the sample mean obtained in Step 3 above with the expected threshold that has been defined in Step 2. If there is a small difference jammed between the two means: the sample mean and the population mean, then the hypothesis is true else it is false.

For every problem under the consideration, we decide upon an issue that is of interest to us. Then there are two distinguishing claims that can be made about the issue that we term as the hypothesis: one of them is the Null Hypothesis denoted by H_0 and the other one is the alternative or the substitute hypothesis denoted by H_1. The above said hypothesis a not observed on an equal basis, special consideration is given to the Null Hypothesis.

There are two common situations:

1. The experiment has been performed in order to invalidate or nullify the null hypothesis. The Null Hypothesis cannot be discarded until the confirmation in opposition to it is adequately strong. For example,

   H_0: Suppose that there is no distinction in flavour of Pepsi and Diet Pepsi against

   H_1: Distinction between the two exists.
2. If either of the two hypotheses stated above is simple enough, we give it more preference in comparison to the other complicated one so that the latter one is not adopted until and unless there exists adequate amount of confirmation in support of the alternate hypothesis. For instance, it is more simple to state that no variation in flavour exists between Pepsi and Diet Pepsi instead of saying that there exists a variation.

The assumptions or hypotheses are the statements that are very prominently used regarding the population parameters such as variance, expected value etc. For instance, the Null Hypothesis H_0 can be the accepted value of the weight of fifteen year old boys in a population is not dissimilar from that of fifteen year old girls. A

hypothesis can also be a statement that concerns a distributional figure of an attribute of interest.

The outcome of a hypothesis test is "Reject H_0 in favour of H_1" or "Do not refuse H_0".

In order to evaluate the behavior of a population that is too large or inaccessible, we can use inference statistics to study the behavior in a sample of population as it allows us to do a more accurate study. Samples are used for evaluation as they are linked to the attributes of the population. Sample means can used to make an estimate of the population mean. The standard value of the sample mean will be approximately equal to the value of the population mean, if an arbitrary sample is selected from a population. The method in which we make a decision about samples to study about attributes of a particular population is known as Hypothesis Testing. Hypothesis Testing is a regular approach to verify the claims or facts regarding an assembly or population.

7.3 VERIFICATION OF THE e-LEARNING FRAMEWORK USING HYPOTHESIS TESTING

In order to confirm our representation Hypothesis Testing was performed of our framework on 100 students (n=100). We deliberate the level of satisfaction and establish that mean to be equivalent to 70% (M=70) (70 ± 10) i.e., μ =10. After calculating one independent sample Z-test we will preserve the Null Hypothesis (M=70%) at a 0.05 significance level (α=0.05). We trace the sample mean as 90% (M=90).

7.3.1 STEP I: STATE THE HYPOTHESIS

We begin with defining the population mean's value in a Null Hypothesis, which is considered as true. The Null Hypothesis H_0 is a statement relative to a population parameter, like the population mean, that is hypothetical to be true. It is the preliminary assumption. Next, it will be checked whether the value stated in the Null Hypothesis is expected to be true. The value of the population mean is 70%.

7.3.2 STEP II: LAY DOWN THE CRITERIA OF DECISION

In order to set a criteria for a decision, we declare the level of impact for the test. During hypothesis testing, we collect data to exemplify that the null hypothesis is false, depending upon the probability of choosing a sample mean from the population (the criterion is the likelihood). In behavioral research analysis, the significance level is usually fixed at 5% in. If the probability of achieving the sample mean is not as much as 5% and if the null hypothesis is true, then the sample we selected is unlikely and so the null hypothesis is turned down. The level of significance or the significance level, refers to a standard upon which a decision is to be made with regards to the value settled in a Null Hypothesis. The criterion depends upon on the possibility of getting a statistic calculated in a sample if the settled value in the null hypothesis is true.

The level of significance is 0.05, which makes α=0.05. Now, in order to uncover the chance of a sample mean from a given population, we have taken the method of standard normal distribution by placing standard normal distribution of Z-scores that are frequently cut offs or defined as critical values for the sample mean values lower than 5% probability of occurrence. We split the alpha value in half in

a non-conditional two tailed, so that an identical proportion of area is placed in lower and upper tails.

Dividing α in half : α/2=0.05/2=0.0250 in each tail.

The region ahead of the critical value of the hypothesis is the rejection region.

7.3.3 STEP III: CALCULATE THE TEST STATISTIC

A test statistic helps us to determine the number of standard deviations or the distance between the sample mean and the population mean. The larger is the value of the test statistic, the more the distance, or the figure of the standard deviation. We can determine a sample mean from the population mean in the null hypothesis. The test statistics value is considered to construct a decision in Step 4. In this stage we judge the generated value to the critical values.

$Z_{statistics}$: $Z_{obtained} = M-\mu/\sigma_M$ where $\sigma_M=\sigma/\sqrt{n}$

where $Z_{statistics}$ is inference statistics that is applied to resolve on the amount of standard deviations in the standard normal distribution.

The value of the test statistics is the resultant value. To formulate a decision, the value of resultant statistics is compared with the critical values.

$\sigma_M=\sigma/\sqrt{n}=10/\sqrt{100} = 1$

$Z_{obtained} = 90-80/10 = 1$

7.3.4 STEP IV: COMPOSE A DECISION

The computed value of the test statistic is used to compose a decision regarding the null hypothesis. The result depends upon the possibility of getting a sample mean, taking into consideration that the value known in the null hypothesis is true. The value of the Null Hypothesis is true if the value obtained in the sample mean

is lower than 5% and then we come up with the decision of discarding the null hypothesis. However, if the probability of getting a sample mean is more than 5% while the null hypothesis is assumed to be true, then we come up with the decision to maintain the Null Hypothesis. Apart from these, the following two decisions could be taken by the analyst:

- **Denial of the Null Hypothesis.** In this case the sample mean is related with a low likelihood of occurrence when the null hypothesis is correct.
- **Retention of the Null Hypothesis.** In this case the sample mean is related with a high likelihood of occurrence when the null hypothesis is correct.

The probability of obtaining a sample mean, taking into account that the value defined in the null hypothesis is true, is settled by the probability value p. The value of p ranges from 0 to 1 and can never be negative. In the next step, we settle the probability of generating a sample mean and at that point we will make a decision to discard the value defined in the null hypothesis, which is settled down at 5% in behavioral research.

In order to derive a conclusion, we place the value of p side by side to the criterion that has been set in Step 2. The probability of obtaining a sample result is p, in view of the fact that the value defined in the Null Hypothesis is true. The p-value obtained for generating a sample result is compared to the significance level.

A decision made related to a value defined in null hypothesis is explained using statistical significance. When the null hypothesis is discarded, we arrive at the significance and when the null hypothesis is retained, we will not be successful in attaining the significance.

Null hypothesis is discarded when the p value is lower than 5% ($p < .05$). Also, when the value of $p = .05$, the conclusion is still to discard the null hypothesis. However, in the case when the value of p is larger than 5% ($p > .05$), then we decide to retain the null hypothesis. Significance is mainly the decision of discarding or retaining the Null Hypothesis. When the value of p is lower than .05, we arrive at significance and the decision is to reject the null hypothesis. When the value of p is greater than .05, we do not succeed to get to significance and the decision is to keep hold of this stage to compose a decision by comparing it with the critical value. The Null Hypothesis is refused if the generated value exceeds a critical value.

Table 7.1 Four Outcomes to make a Decision

	Decision	
Truth in the population	**Retain the Null**	**Reject the Null**
Truth	Correct (1-α)	Type I Error-α
Falsity	Type II Error-β	Correct (1-β)

In Step 4, we come to a decision whether to keep hold of or discard the null hypothesis. As we are evaluating a sample and not the total population, it is likely that the conclusion may be incorrect. Table 7.1 above shows that there are four decision options regarding the falsity and truth of the decision that we construct concerning a null hypothesis:

- The decision regarding retaining of the null hypothesis might be right.

- The decision regarding retaining of the null hypothesis might be incorrect.
- The decision regarding discarding of the null hypothesis might be right.
- The decision regarding discarding of the null hypothesis might be incorrect.

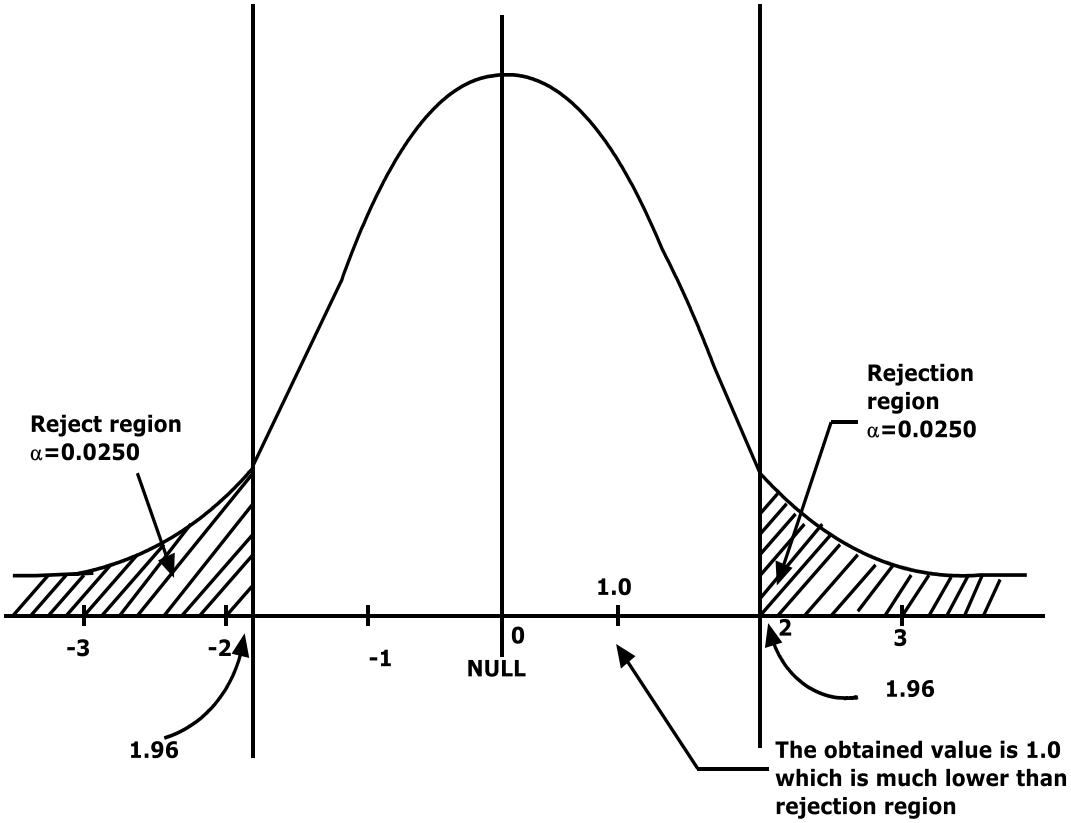

Fig 7.1 Acceptance of the Hypothesis

From Fig 7.1 we bring to a close that our framework has a reception of 70% supporting the Null Hypothesis.

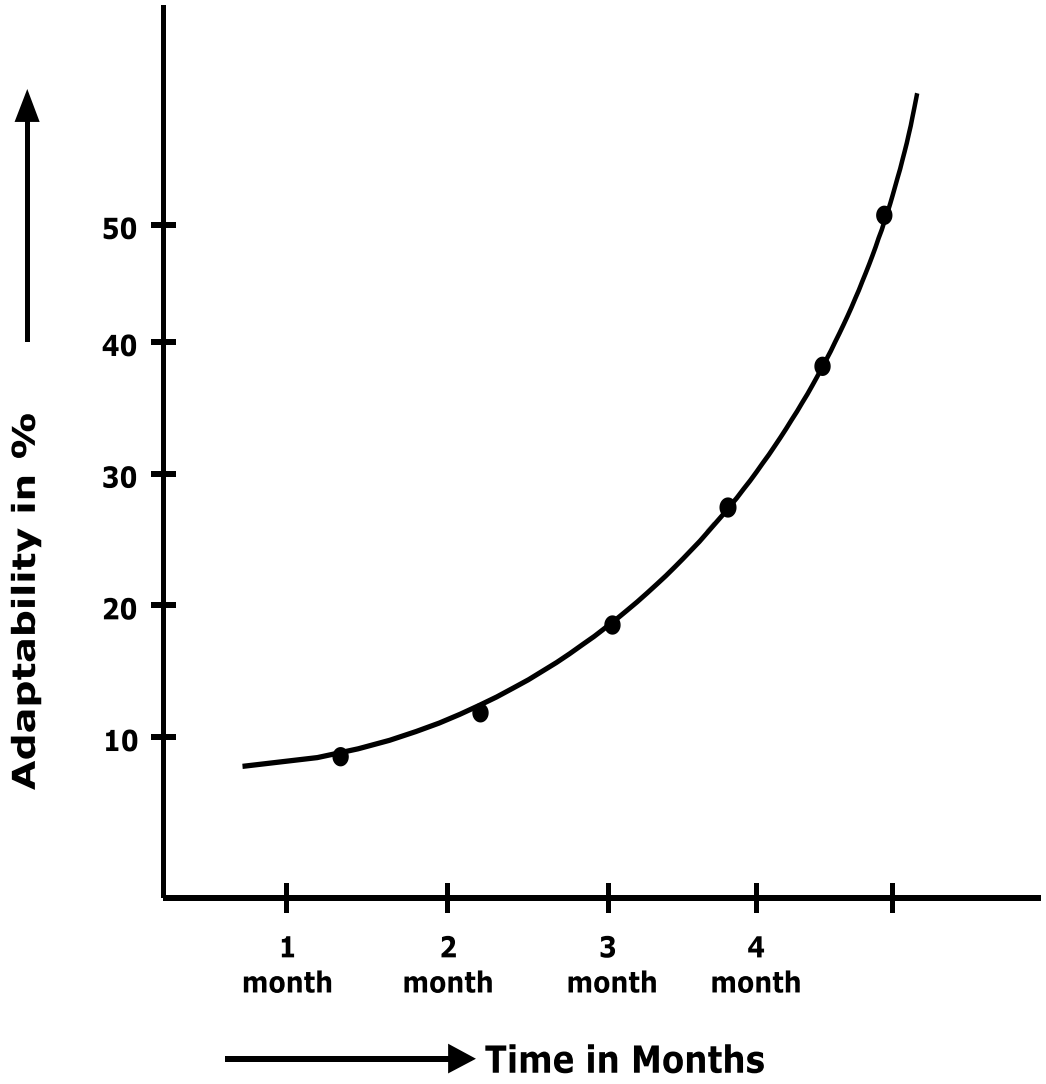

Fig 7.2. Framework Penetration Rate

The figure above shows the adaptability of our proposed framework with time. From the study we found that the penetration of our model increased exponentially in the areas where the acceptability to normal learning was a big issue.

7.4 CONCLUSION

We can concludes our work by developing a framework by means of Web 3.0 for e-Learning. The foremost component that distinguishes it from traditional e-Learning is the utilization of Activity Theory (AT) and Normative Multi Agent

System (NorMAS). For RDF generation, the NormATe-L framework is applied and the constraints are characteristically established by the use of Deontic Logic. In future we can extend our work which involves development of NormATe-L language on principles of Deontics.

REFERENCES

[1] Keegan, D. (1996). Foundations of distance education. Psychology Press.

[2] Shneiderman, B., & Ben, S. (2003). Designing the user interface. Pearson Education India.

[3] Bricken, M. (1991). Virtual reality learning environments: Potentials and Challenges. ACM SIGGRAPH Computer Graphics, 25(3), 178-184.

[4] Fuentes, R., Gomez-Sanz, J.J. & Pavon, J. (2004). Activity theory for the analysis and design of multi-agent systems. In Agent-Oriented Software Engineering IV (pp. 110-122). Springer Berlin Heidelberg.

[5] Nichols.M, (2008). e-Learning in context. http://akoatotearoa.ac.nz/sites/default/ng/group-661/n877-1-elearning-in-context.pdf.

[6] Craciunas, S. & Elsek, I. (2009). The standard model of an e-learning platform. Bucharest, Romania, (Chapter 2).

[7] Garrison, D.R., & Shale, D. (1987). Mapping the boundaries of distance education: Problems in defining the field. The American Journal of Distance Education, 1(1), 7-13.

[8] Khan, B. H. (2001). Web-based Training. Educational Technology Publications.

[9] Hall, B. (1997). Web-Based Training Cookbook. John Wiley & Sons.

[10] Schank, R.C. (2001). Designing World-Class E-Learning. McGraw-Hill Professional Publishing.

[11] Hamada, Mohamed. "An integrated virtual environment for active and collaborative e-Learning in theory of computation." Learning Technologies, IEEE Transactions on 1.2 (2008): 117-130.

[12] Kamsin, Amirrudin, and E. Is. "Is e-learning the solution and substitute for conventional learning." International journal of the computer, the internet and management 13.3 (2005): 79-89.

[13] Gamalel-Din, Shehab A. "Smart e-Learning: A greater perspective; from the fourth to the fifth generation e-learning." Egyptian Informatics Journal 11.1 (2010): 39-48.

[14] Wan, Zeying, Yinglei Wang, and Nicole Haggerty. "Why people benefit from e-learning differently: The effects of psychological processes on e-learning outcomes." Information & Management 45.8 (2008): 513-521.

[15] Chen, Lina. "About e-Learning Application in Communication Teaching."Web-based Learning,2008.ICWL 2008.Seventh International Conference on. IEEE, 2008.

[16] Fetaji, Bekim, and Majlinda Fetaji. "E-learning Indicators Approach to Developing E- learning Software Solutions." EUROCON, 2007. The International Conference on" Computer as a Tool". IEEE, 2007.

[17] Nait-Sidi-Moh, A., Jaafar Gaber, and M. Wack. "Modeling and implementation of a pervasive e-learning application." Multimedia Computing and Systems (ICMCS), 2011 International Conference on.

IEEE, 2011.

[18] Na, Shu, and Liu Jing. "The Impact of Learner Factor on E-Learning Quality."E-Learning, E-Business, Enterprise Information Systems, and E-Government, 2009.EEEE'09.International Conference on.IEEE, 2009.

[19] Klimova, BlankaFrydrychova, and Petra Poulova. "Tutor as an important e-learning support." Procedia Computer Science 3 (2011): 1485-1489.

[20] Fardoun, Habib, Francisco Montero, and Víctor López Jaquero. "eLearniXML: Towards a model-based approach for the development of e-Learning systems considering quality." Advances in Engineering Software 40.12 (2009): 1297-1305.

[21] Luminita, DeftaCostinela. "Information security in E-learning Platforms."Procedia-Social and Behavioral Sciences 15 (2011): 2689-2693.

[22] Yahya, Yazrina, Doreen Ng Nielsen, and Muriati Mukhtar. "Innovation in teaching and learning using service oriented approach." Electrical Engineering and Informatics (ICEEI), 2011 International Conference on.IEEE, 2011.

[23] Nam, Chang S., and Tonya L. Smith-Jackson. "Web-based learning environment: A theory-based design process for development and evaluation." Journal of Information Technology Education 6 (2007): 23.

[24] Jin Hu, Qian, Min Wu, and Jia hui Qi. "Web-Based “College English Intensive Reading” e-Learning Courses Design and Implementation of Interaction. "Education Technology and Computer Science

(ETCS), 2010 Second International Workshop on. Vol. 1. IEEE, 2010.

[25] Khalid, Sh Umar, et al. "An adaptive e-learning framework to supporting new ways of teaching and learning." Information and Communication Technologies, 2009.ICICT'09, International Conference on.IEEE, 2009.

[26] Jamuna, R. S., and M. S. Ashok. "A survey on service-oriented architecture for E-learning system."Intelligent Agent & Multi-Agent Systems, 2009.IAMA 2009.International Conference on.IEEE, 2009.

[27] Poklemba, Tomas, I. Sivy, and Zdeněk Havlice. "Maintenance software processes for web 2.0 based learning management systems." Emerging eLearning Technologies and Applications (ICETA), 2011 9th International Conference on. IEEE, 2011.

[28] Liu, Xiaofei, Abdulmotaleb El Saddik, and Nicolas D. Georganas. "An Implementable Architecture of an e-Learning System."Electrical and Computer Engineering, 2003. IEEE CCECE 2003. Canadian Conference on.Vol. 2.IEEE, 2003.

[29] Chatti, Mohamed Amine, Matthias Jarke, and Dirk Frosch-Wilke. "The future of e-learning: a shift to knowledge networking and social software." International journal of knowledge and learning 3.4 (2007): 404-420.

[30] Cheng, Zhifen, Tinglei Huang, and JiaNong. "An extensible development platform for SOA- based e-learning system."Computer Science and Software Engineering, 2008 International Conference on. Vol. 5.IEEE, 2008.

[31] Liaw, Shu-Sheng, Hsiu-Mei Huang, and Gwo-Dong Chen. "An activity-theoretical approach to investigate learners' factors toward e-learning systems."Computers in Human Behavior 23.4 (2007): 1906-1920.

[32] Mohammed Khalidi Idrissi, Farid Merrouch, Samir Bennani, "E-Learning Models Based on Activity Theory", IADIS International Conference e-Learning 2009.

[33] Ayse Kok, "An Activity System Perspective of E-Learning and the Reframing of Knowledge", International Journal of The Computer, the Internet and Management Vol. 18.No.2 (May - August, 2010) pp 17 – 25.

[34] Hung, Shin-Yuan, et al. "Exploring E-learning Effectiveness Based on Activity Theory: An Example of Asynchronous Distance Learning." MIS REVIEW: An International Journal 15.1 (2009): 63-87.

[35] Mwanza, Daisy, and Yrjo Engestrom. "Pedagogical adeptness in the design of e-learning environments: experiences from the Lab@ Future Project." World Conference on E-Learning in Corporate, Government, Healthcare, and Higher Education. Vol. 2003. No. 1. 2003.

[36] Greenhow, Christine, and Brad Belbas. "Using activity-oriented design methods to study collaborative knowledge-building in e-learning courses within higher education." International Journal of Computer-Supported Collaborative Learning2.4 (2007): 363-391.

[37] Bradshaw J., "Software Agents", MIT, AAAI Press, Cambridge, USA, 1997.

[38] Carolan T., Collins B. et. al., "Intelligent Agents", University of Dublin,

Ireland, 1997, http://ntrg.cs.tcd.ie/cs4/agents/main3.html.

[39] Panteleyev, Michael G., et al. "Intelligent educational environments based on the semantic Web technologies." Artificial Intelligence Systems, 2002.(ICAIS 2002). 2002 IEEE International Conference on. IEEE, 2002.

[40] Duo, Sun, and Zhou Cai Ying. "Personalized E-learning System Based on Intelligent Agent."Physics Procedia 24 (2012): 1899-1902.

[41] Stoyanov, Stanimir, et al. "Service-oriented and agent-based approach for the development of InfoStation eLearning intelligent system architectures."Intelligent Systems, 2008. IS'08. 4th International IEEE Conference. Vol. 1. IEEE, 2008.

[42] Mikic Fonte, Fernando A., Juan C. Burguillo, and Martín Llamas Nistal. "An intelligent tutoring module controlled by BDI agents for an e-learning platform."Expert Systems with Applications 39.8 (2012): 7546-7554.

[43] Gladun, Anatoly, et al. "An application of intelligent techniques and semantic web technologies in e-learning environments." Expert Systems with Applications36.2 (2009): 1922-1931.

[44] Guha, Radha. "Toward the intelligent web systems." Computational Intelligence, Communication Systems and Networks, 2009. CICSYN'09. First International Conference on. IEEE, 2009.

[45] Hui, Wang. "The status and development prospect of information construction of regional comprehensive universities from the view of Web3.0." Uncertainty Reasoning and Knowledge Engineering (URKE), 2011 International Conference on. Vol. 2. IEEE, 2011.

[46] Kasimati, Anna, and Efpraxia Zamani. "Education and learning in the Semantic Web." Informatics (PCI), 2011 15th Panhellenic Conference on IEEE, 2011.

[47] Chang, Yi-Hsing, and Kai-Xiang Chang. "An efficiently interactive social website based on web 3.0." Machine Learning and Cybernetics (ICMLC), 2011 International Conference on Vol. 2.IEEE, 2011.

[48] Alice, P. Sheba, A. M. Abirami, and A. Askarunisa. "A semantic based approach to organize e-Learning through efficient information retrieval for interview preparation." Recent Trends In Information Technology (ICRTIT), 2012 International Conference on. IEEE, 2012.

[49] Shrivastava, Gulshan, Kavita Sharma, and Aparna Bawankan. "A new framework semantic web technology based e-learning."Environment and Electrical Engineering (EEEIC), 2012 11th International Conference of IEEE, 2012.

[50] Abbas, Zaheer, et al. "A semantic grid-based e-learning framework (SELF)." Cluster Computing and the Grid, 2005. IEEE International Symposium on.Vol. 1.IEEE, 2005.

[51] Giannakos, Michail N., and VasileiosLapatas. "Towards Web 3.0 Concept for Collaborative E-Learning."Proceedings of the Multi-Conference on Innovative Developments in ICT.ICTEL.Vol. 10. 2010.

[52] Almeida, Fernando LF, and Justino MR Lourenço. "eCreation of value with Web 3.0 Technologies." Information Systems and Technologies

(CISTI), 2011 6th Iberian Conference on.IEEE, 2011.

[53] Xu, Zhengfang, Zheng Yin, and Abdulmotaleb El Saddik. "A web services oriented framework for dynamic e-learning systems." Electrical and Computer Engineering, 2003. IEEE CCECE 2003. Canadian Conference on.Vol. 2.

[54] Aroyo, Lora, and DarinaDicheva. "The new challenges for e-learning: The educational semantic web." Educational Technology & Society 7.4 (2004): 59-69.

[55] Thyagharajan, K.K., and Ratnamanjari Nayak. "Adaptive content creation for personalized e-Learning using web services. "Journal of Applied Sciences Research 3.9 (2007): 828-836.

[56] Dhanda, N., Darbari, M., Ahuja, N. J., & Siddiqui, I. A. " A Critical Review on e-Learning Prospective: With Special Reference to Migration from Web 2.0 to Web 3.0", International Journal of Scientific & Engineering Research, Volume 4, Issue 9, September-2013.

[57] Somekh, B. (2007). Pedagogy and learning with ICT: Researching the art of innovation. New York: Routledge.

[58] Hodas, S. (1993). Technology refusal and the organizational culture of schools. Education Policy Analysis Archives, 1(10).Retrieved from http://epaa.asu.edu/epaa/v1n10.html

[59] Chambers, A., & Bax, S. (2006). Making CALL work: Towards normalisation. System, 34(4), 465-479. doi:10.1016/j.system.2006.08.001

[60] Hrastinski, S. (2009). A theory of online learning as online participation. Computers & Education, 52, 78-82. doi:10.1016/j.compedu.2008.06.009

[61] Vygotksy, L. S. (1978). Mind in society: Development of higher psychological processes. Cambridge, MA: Harvard University Press.

[62] Vygotksy, L. S. (1981). The genesis of higher mental functions. In J. V. Wertsch (Ed.), The concept of activity in Soviet psychology (pp. 144-188). Armonk, New York: Sharpe.

[63] Lantolf, J. P., & Appel, G. (1994). Theoretical framework: An introduction to Vygotskian perspectives on second language research. In J. P. Lantolf & G. Appel (Eds.), Vygotskian approaches to second language research (pp. 1-32). Norwood, New Jersey: Ablex.

[64] Kaptelinin, V., Nardi, B., & Macaulay, C. (1999). The activity checklist: A tool for representing the "space" of context. Interactions, 6 (4), 27-39. Retrieved from http://interactions.acm.org.

[65] Cole, M., & Engestrom. Y. (1993). A cultural-historical approach to distributed cognition. In G. Salomon (Ed.), Distributed cognitions: Psychological and educational considerations (pp. 1- 46). Cambridge: Cambridge University Press.

[66] Van Aalst, J., & Hill, C. M. (2006). Activity theory as a framework for analysing knowledge building. Learning Environments Research, 9(1), 23-44. Retrieved from http://www.springer.com/education/journal/10984

[67] Nardi, B. (1996). Activity theory and human-computer interaction. In B. Nardi (Ed.), Context and consciousness: Activity theory and human-computer interaction (pp. 7-17). Cambridge, MA: MIT Press.

[68] Engestrom, Y. (2001). Expansive learning at work: Toward an activity-theoretical conceptualization. Journal of Education and Work, 14, 133-156. doi: 10.1080/13639080020028747

[69] Engestrom, Y. (1987). Learning by expanding: an activity- theoretical approach to developmental research. Helsinki: Orienta-Konsultit. Retrieved from http://communication.ucsd.edu/MCA/Paper/Engestrom/expanding/toc.htm

[70] Leontev, A. N. (1981). The problem of activity in psychology. In J. V. Wertsch (Ed.), The concept of activity in Soviet psychology (pp. 37-71). Armonk, New York: Sharpe.

[71] Wertsch, J. V., del Rio, P., & Alvarez, A. (1995). Socio cultural studies: History, action, and mediation. In J. V. Wertsch, P. del Rio, & A. Alvarez (Eds.), Socio cultural studies of mind (pp. 1- 34). Cambridge: Cambridge University Press.

[72] Engestrom, Y. (1993). Developmental studies of work as a test bench of activity theory: The case of primary care medical practice. In J. Lave & S. Chaiklin, (Eds.), Understanding practice: Perspectives on activity and context (pp. 64-103). Cambridge: Cambridge University Press

[73] Saljo, R. (1999). Learning as the use of tools: A socio cultural perspective on the human-technology link. In K. Littleton & P. Light (Eds.), Learning

with computers: Analysing productive interaction (pp. 144 -161). London: Routledge.

[74] Barab, S. A., Evans, M. A., & Baek, E -O. (2004). Activity theory as a lens for characterizing the participatory unit. In D. H. Jonassen (Ed.), Handbook of research on educational communities and technology (pp. 199 – 214). Mahwah, NJ: Lawrence Erlbaum Associates.

[75] Jonassen, D.H. (2000). Revisiting activity theory as a framework for designing student-centered learning environments. In D. H. Jonassen & S. M. Land (Eds.), Theoretical foundations of learning environments (pp. 89-121). Mahwah, New Jersey:Lawrence Erlbaum.

[76] Vygotsky, L. S. (1987). Thinking and speech. In R. W. Rieber & A. S. Carton (Eds.), The collected works of L. S. Vygotsky, volume 1: Problems of general psychology. New York: Plenum.

[77] Issroff, K., & Scanlon, E. (2002). Using technology in higher education: An activity theory perspective. Journal of Computer Assisted Learning, 18, 77-83. doi: 10.1046/j.0266-4909.2001.00213.x.

[78] Jonassen, D. H. (2000). Revisiting activity theory as a framework for designing student centered learning environments. In D. H. Jonassen & S. M. Land (Eds.), Theoretical foundations of learning environments (pp. 89-121). Mahwah, New Jersey: Lawrence Erlbaum.

[79] Jonassen, D. H., & Rohrer-Murphy, L. (1999). Activity theory as a framework for designing constructivist learning environments. Educational

Technology, Research and Development, 47(1), 61-80. Retrieved from: http://www.springer.com/education/learninginstruction/journal/11423.

[80] Kaptelinin, V. (2005). The object of activity: Making sense of the sense maker. Mind,Culture, and Activity, 12(1), 4-18. doi: 10.1207/s15327884mca1201_2

[81] Kutti, K. (1996). Activity theory as a potential framework for human-computer interaction research. In B. Nardi (Ed.), Context and consciousness: Activity theory and human computer interaction (pp. 17-44). Cambridge, MA: MIT Press

[82] Yamagata-Lynch, L. C. (2003). Using activity theory as an analytic lens for examining technology professional development in schools. Mind, Culture, and Activity, 10(2), 100-119. doi: 10.1207/ 7884MCA1002_2.

[83] Jonassen, D. H., & Land, S. M. (2000). Preface. In D. H. Jonassen & S. M. Land (Eds.), Theoretical foundations of learning environments (pp. iii-ix). Mahwah, New Jersey: Lawrence Erlbaum.

[84] Gifford, B. R., & Enyedy, N. D. (1999). Activity centered design: Towards a theoretical framework for CSCL. Paper presented at the proceedings of the 1999 Conference on Computer Support for Collaborative Learning, Palo Alto, California. Retrieved http://portal.acm.org/citation.cfm?id=1150262.

[85] Scanlon, E., & Issroff, K. (2005). Activity theory and higher education: Evaluating learning technologies. Journal of Computer Assisted Learning 21(6), 430-439. doi: 10.1111/j.1365-2729.2005.00153.x.

[86] Hewitt, J. (2004). An exploration of community in a knowledge forum classroom. In S. A. Barab, R. Kling, & J. H. Gray (Eds.), Designing for virtual communities in the service of learning (pp. 210-238). Cambridge: Cambridge University Press.

[87] Tuomi-Grohn, T., & Engestrom, Y. (2003). Conceptualizing transfer: From standard notions to developmental perspectives. In T. Tuomi-Grohn & Y. Engestrom (Eds.), Between school and work: New perspectives on transfer and boundary-crossing (pp.19-38). Amsterdam: Pergamon. 333

[88] Tuomi-Grohn, T., Engestrom, Y., & Young, M. (2003). From transfer to boundary-crossing between school and work as a tool for developing vocational education: An introduction. In T. Tuomi-Grohn & Y. Engestrom (Eds.), Between school and work: New perspectives on transfer and boundary-crossing (pp. 1-15). Amsterdam:Pergamon.

[89] Finlay, I. (2008). Learning through boundary-crossing: Further education lecturers learning in both the university and workplace. European Journal of Teacher Education, 31, 73-87. doi: 10.1080/02619760701845024

[90] Mwanza, D., & Engestrom, Y. (2003, 7–11 November). Pedagogical adeptness in the design of e-learning environments: Experiences from Lab@Future project. Paper presented at the E-Learn 2003 International Conference on E-Learning in Corporate, Government, Healthcare, & Higher Education, Phoenix, AR.

[91] Edwards, R. (2005, 14-17 September). Contexts, boundary zones and boundary objects in lifelong learning. Paper presented at the British

Educational Research Association Annual Conference, University of Glamorgan.

[92] Jochems et al (2004), "Integrated e-Learning – implications for pedagogy, technology and organisation", Open and flexible learning series, Routledge Falmer, London and New York.

[93] Brian, Getting, (2007) "Basic Definitions: Web 1.0, Web. 2.0, Web 3.0", <http://www.practicalecommerce.com/articles/464-Basic-Definitions-Web-1-0-Web-2-0-Web-3-0>.

[94] Maged, N. Kamel Boulos & Steve, Wheeler (2007), "The emerging Web 2.0 social software: an enabling suite of sociable technologies in health and health care education", Health Information and Libraries Journal, Pp: 2-23.

[95] Tim Berners-Lee. The World Wide Web: A very short personal history, In: <http://www.w3.org/People/Berners-Lee/ShortHistory.html>, 1998.

[96] San, Murugesan (2007), "Understanding Web 2.0", Journal of IT Professional.

[97] Nova, Spivack (2011), "Web 3.0: The Third Generation Web is Coming", http://lifeboat.com/ex/web.3.0.

[98] Jane, Greenberg & Stuart, Sutton & D. Grant, Campbell (2003), "Metadata: A Fundamental Component of the Semantic Web", Bulletin of the American Society for Information Science and Technology Volume 29, Issue 4, pages 16–18.

[99] Rosenberg, M. J. (2005). Beyond e-learning: Approaches and technologies to enhance organizational knowledge, learning, and performance. John Wiley & Sons.

[100] Omicini, A., Ricci, A., & Viroli, M. (2008). Artifacts in the A&A meta-model for multi-agent systems. Autonomous agents and multi-agent systems, 17(3), 432-456.

[101] Paolo Giorgini, Jorg P.Muller, James Odell (Eds.): Agent-Oriented Software Engineering IV, 4th International Workshop, AOSE 2003, Melbourne, Australia, July 15, 2003

[102] Hennicker. R, Koch. N. (2000). "A UML-based methodology for hypermedia design". Proceedings of the Unified Modeling Language Conference, UML´2000, Evans A. and Kent S. (Eds.), 410-424.

[103] Horling. B, Lesser. V, Vincent, R (2000), "Multi-Agent System Simulation Framework", 16th IMACS World Congress 2000 on scientific Computation, AppliedMathematics and Simultation.

[104] Dhanda, N., Darbari, M., & Ahuja, N. J. (2012). Development of Multi Agent Activity Theory e-Learning (MATe-L) Framework Focusing on Indian Scenario. International Review on Computers & Software, 7(4).

[105] Dhanda, N., Darbari, M., Ahuja, N. J., & Siddiqui, I. A. An Adaptive Normative Multi-Agent System Using Web 3.0 for E-Learning Platform. AJIT-e: Online Academic Journal of Information Technology 2013, Summer/Yaz – Cilt/Vol:4 - Sayı/Num: 12

[106] Vargas-Vera, M., & Lytras, M. (2008). Personalized Learning Using Ontologies and Semantic Web Technologies. In M. Lytras, J. Carroll, E. Damiani & R. Tennyson (Eds.), Emerging Technologies and Information Systems for the Knowledge Society (Vol. 5288, pp. 177-186): Springer Berlin / Heidelberg.

[107] Paolucci, M., Broll, G., Hamard, J., Rukzio, E., Wagner, M., & Schmidt, A. (2008). Bringing Semantic Services to Real-World Objects. [10.4018/jswis.2008010103]. International Journal on Semantic Web and Information Systems, 4(1), 35-49.

[108] Parrish, P. (2004). The trouble with learning objects. [10.1007/BF02504772]. Educational Technology Research and Development, 52(1), 49-67.

[109] Emina, J. (2009). Preparation of the learning content for semantic e-learning environment. [10.1016/j.sbspro.2009.01.147]. Procedia - Social and Behavioral Sciences, 1(1), 824-828.

[110] Mitschick, A.,Pietschmann, S., & Meißner, K. (2010). An Ontology-Based, Cross-Application Context Modeling and Management Service [10.4018/jswis.2010010103]. International Journal on Semantic Web and Information Systems, 6(1), 39-54.

[111] Berners-Lee, T., Hendler, J., & Lassila, O. (2001, May 2001). The Semantic Web. Scientific American.

[112] McGuinness, D. L., & Van Harmelen, F. (2004). OWL web ontology language overview. W3C recommendation, 10, 2004-2003.

[113] Singh, R., Iyer, L., & Salam, A. F. (2005). Semantic eBusiness. [10.4018/jswis.2005010102]. International Journal on Semantic Web and Information Systems, 1(1), 19-35.

[114] Gladun, A., Rogushina, J., Garc, a-Sanchez, F., Mart, nez, B., . . . ndez-Breis, J. T.(2009). An application of intelligent techniques and semantic web technologies in e-learning environments. Expert Syst. Appl., 36(2), 1922-1931.

[115] Mazumdar, B. D., & Mishra, R. B. (2010). Customer Orientation Based Multi-Agent Negotiation for B2C e-Commerce. International Journal of Agent Technologies and Systems, 2(2), 24-48. doi: 10.4018/jats.2010040103

[116] Arora, M., & Devi, M. S. (2011). Design of Multi Agent System for Resource Allocation and Monitoring. International Journal of Agent Technologies and Systems, 3(1), 1-10. doi: 10.4018/jats.2011010101

[117] Zouhair, A., En-Naimi, E. M., Amami, B., Boukachour, H., Person, P., & Bertelle, C. (2013, 29-31 May 2013). Intelligent tutoring systems founded of incremental dynamic case based reasoning and multi-agent systems (ITS-IDCBR-MAS). Paper presented at the Advanced Logistics and Transport (ICALT), 2013 International Conference on

[118] Chen, C.-M., Peng, C.-J., & Shiue, J.-Y. (2008). Ontology-based concept map for planning personalized learning path.

[119] Lemnitzer, L., Mossel, E., Simov, K., Osenova, P., & Monachesi, P. (2008). Using a Domain-Ontology and Semantic Search in an E-Learning

Environment. In M. Iskander (Ed.), Innovative Techniques in Instruction Technology, E-learning, E-assessment, and Education (pp. 279-284): Springer Netherlands

[120] Pandey, N., Sahu, S., Tyagi, R. K., & Dwivedi, A. (22-23 Feb. 2013). Learning algorithms For intelligent agents based e-learning system. Paper presented at the Advance Computing Conference (IACC), 2013 IEEE 3rd International.

[121] Gary S. Becker, The Economic Approach to Human Behavior, University of Chicago Press, September 1978.

[122] Jurgen Habermas, The Theory of Communicative Action, Volume 1: Reason and the Rationalization of Society. Beacon Press, 1985.

[123] Edna Ullmann-Margalit, The Emergence of Norms, Clarendon Press, 1977.

[124] James Coleman, Foundations of Social Theory, Belknap Press, 1990.

[125] Jon Elster, Social norms and economic theory, The Journal of Economic Perspectives 3(4) (1989), 99–117.

[126] Raimo Tuomela, The Importance of Us: A Philosophical Study of Basic Social Notions, Stanford Series in Philosophy, Stanford University Press, 1995.

[127] Adrian Perreau de Pinninck, Carles Sierra and W. Marco Schorlemmer, Distributed norm enforcement: Ostracism in open multi-agent systems, In Pompeu Casanovas, Giovanni Sartor, Nuria Casellas, and Rossella Rubino, editors Computable Models of the Law: Languages, Dialogues, Games,

Ontologies, volume 4884 of Lecture Notes in Computer Science, pages 275–290. Springer, 2008.

[128] Robert Axelrod, An evolutionary approach to norms, The American Political Science Review 80(4) (1986), 1095–1111.

[129] George A. Akerlof, The economics of caste and of the rat race and other woeful tales, The Quarterly Journal of Economics 90(4) (November 1976), 599–617.

[130] Joshua M. Epstein, Learning to be thoughtless: Social norms and individual computation, Computational Economics 18(1) (2001), 9–24.

[131] Rosaria Conte and Cristiano Castelfranchi, Understanding the effects of norms in social groups through simulation, In Nigel Gilbert and Rosaria Conte, editors, Artificial societies: the computer simulation of social life, pages 252–267. UCL Press, London, 1995.

[132] Magnus Boman, Norms in artificial decision making, Artificial Intelligence and Law 7(1) (1999), 17–35.

[133] Harko Verhagen, Simulation of the Learning of Norms, Social Science Computer Review 19(3) (2001), 296–306.

[134] Mathew J. Hoffmann, Entrepreneurs and Norm Dynamics: An Agent-Based Model of the Norm Life Cycle. Technical report, Department of Political Science and International Relations, University of Delaware, USA, 2003.

[135] Bastin Tony Roy Savarimuthu, Stephen Cranefield, Maryam Purvis and Martin Purvis, Role model based mechanism for norm emergence in

artificial agent societies, In Coordination, Organizations, Institutions, and Norms in Agent Systems III, volume 4870 of Lecture Notes in Computer Science, pages 203–217. Springer, Berlin/Heidelberg, 2008.

[136] Martha Finnemore and Kathryn Sikkink, International Norm Dynamics and Political Change, International Organization 52(4) (1998), 887–917.

[137] Sandip Sen and Stephane Airiau, Emergence of norms through social learning, In Proceedings of the Twentieth International Joint Conference on Artificial Intelligence (IJCAI), pages 1507–1512. AAAI Press, 2007.

[138] Yoav Shoham and Moshe Tennenholtz, Emergent conventions in multi-agent systems: Initial experimental results and observations, In Proceedings of the Third International Conference on the Principles of Knowledge Representation and Reasoning (KR), pages 225–231, San Mateo, CA, USA, 1992. Morgan Kaufmann.

[139] Giulia Andrighetto, Marco Campenni, Federico Cecconi and Rosaria Conte, The complex loop of norm emergence: A simulation model. In Shu-Heng Chen, Claudio Cioffi-Revilla, Nigel Gilbert, Hajime Kita, Takao Terano, Keiki Takadama and Guillaume Deffuant, editors, Simulating Interacting Agents and Social Phenomena, volume 7 of Agent-Based Social Systems, pages 19–35. Springer,2010.

[140] Mwanza, Daisy, and Yrjo Engestrom (2005), "Managing content in E-learning environments." British Journal of Educational Technology 36.3, pp. 453-463.

[141] Brewka, Grchard (1989), “Non-Monotonic Logics: A Brief Overview”, AI

Communications: The European Journal of Artificial Intelligence, 88-97.

[142] Hayes, Gary.(2006) "Virtual Worlds, Web 3.0 and Portable Profiles." Personalize Media .

[143] R. A. Fisher (1925), "Statistical Methods for Research Workers", Edinburgh: Oliver and Boyd, 1925, p.43.

[144] Lehmann, E.L.; Romano, Joseph P. (2005). Testing Statistical Hypotheses (3E ed.). New York: Springer. ISBN 0-387-98864-5.

[145] Bakan, David (1966). "The test of significance in psychological research" Psychological Bulletin 66 (6): 423–437. doi:10.1037/h0020412

CURRICULUM VITAE

NAMRATA DHANDA
House No: 209 Sujanpura,
Om Nagar Road,
Alambagh,
Lucknow-05
Contact No: 9415094250

OBJECTIVE

Looking for a prospect where technical competencies are valued and I can make a meaningful contribution to the growth of organization and be a part of technical innovation**.**

WORK EXPERIENCE – 13+ years teaching experience as follows:

- Working as an Associate Professor and Head, Department of Computer Science / Information Technology in Goel Institute of Technology and Management, Lucknow from October'09 till date.
- Worked as a Sr. Lecturer/Assistant Professor in Amity Institute of Information Technology, Amity University, Lucknow Campus from August'05 till October'09.
- Worked in Babu Banarsi Das National Institute of Technology and Management, Lucknow from September'01 till August'05 in the Department of Information Technology.

SUBJECTS TAUGHT

- Database Management Systems

- Automata Theory
- Operating System
- Data Structures
- Algorithm Analysis and Design
- Compiler Design
- Data Compression
- Computer Graphics
- Discrete Mathematical Structures
- Graph Theory

EXTRA DUTIES PERFORMED

- Was appointed as an External Examiner for various Practical Examinations held by Integral University, Purvanchal University, Agra University and UP Technical University.
- Had been a Paper Setter for End Semester Examinations conducted by the above mentioned Universities.
- Had been a Co-ordinator of MCA in Amity Institute of Information Technology.
- Taken Classes for IGNOU-MCA, BCA .
- Was appointed as Deputy Head Examiner in UPTU External Evaluation.
- Was appointed as Deputy Center Incharge during UPSEE Counselling.

ACADEMIC QUALIFICATIONS:

- Pursuing Phd from UPES, Dehradun since January, 2011.

- M.Tech in Computer Science & Engg from U.P Technical University, Lucknow

  with CPI 10 in year 2006.
- B-Tech in Computer Science & Engg from U.N.S Institute of Engineering & Technology, Purvanchal University, Jaunpur (U.P.) in 2001 with 75.6% aggregates marks.
- Senior Secondary School Certificate Examination (10+2) from U.P. Board, Loreto Convent College, Lucknow in 1996 with 72% marks.
- Secondary School Examination (10th) from St Agnes Loreto Day School, Lucknow in 1994 with 84.3% marks.

PAPERS PUBLISHED:

- Darbari, M., & Dhanda, N. (2010). Applying constraints in model driven knowledge representation framework. International Journal of Hybrid Information Technology, 3(3), 15-22.
- Dhanda, N., Darbari, M., & Ahuja, N. J. (2012). Development of Multi Agent Activity Theory e-Learning (MATeL) Framework Focusing on Indian Scenario. International Review on Computers & Software, 7(4).
- Dhanda, N., Darbari, M., Ahuja, N. J., & Siddiqui, I. A. (2013). An Adaptive Normative Multi-Agent System Using Web 3.0 for E-Learning Platform. AJIT-e: Online Academic Journal of Information Technology 2013 Summer/Yaz – Cilt/Vol: 4 - Sayı/Num: 12
- Dhanda, N., Darbari, M., Ahuja, N. J., & Siddiqui, I. A.(2013). A Critical Review on E-Learning Prospective: With Special Reference to Migration

from Web 2.0 to Web 3.0. International Journal of Scientific & Engineering Research, Volume 4, Issue 9.

PERSONAL PROFILE*:*

Date of Birth:	05th October 1978
Father's Name:	Shri Harish Kumar
Mother's Name:	Late. Smt Saroj Bala
Permanent Address:	209 Sujanpura, Om Nagar Road, Alambagh, Lucknow-226005
E-mail:	ndhanda510@gmail.com
Phone No.	9415094250(M)
Nationality:	Indian
Sex	Female
Language Known:	English, Hindi, Punjabi

STRENGTH:

Persistent, Hard Working, Fast Learner

(NAMRATA DHANDA)