INTRODUCTION

Learning is an integral part of life as it has a significant contribution in the growth of an individual. It is a process that involves a number of complexities and the factors that mainly affect this process include a) learning material, b) the skills and expertise of the teacher in the particular subject, c) the determination and willingness of a student to learn, and d) certain similar factors on whose interaction this whole process of learning is dependent. These days the traditional methods of teachings in the classrooms are largely overpowered by virtual means which have given rise to several other aspects in the course of learning. The process of learning has witnessed a sea amount of change due to the emergence of new technologies which have played a vital role in introducing the new means of learning through the facilities available of Internet. The theory of learning is largely based on constructiveness and effectiveness of the learning procedures. Although, various technical means are being brought up but even today learning is largely centred around the teacher with traditional teacher teaching in the classrooms, delivering lessons, practicing and involving students on a basic level only.

Therefore, teachers should evolve their teaching abilities into such a manner that the pattern of learning has its centre of focus on the learner and not the teacher itself. Without a doubt the process of learning involves the synchronization of the combined efforts of both teacher and learner and that too with equal weightage. The willingness of the learner can be aroused through various means and methods such as assignments, notes, questionnaires, group discussions, online query resolution along with the quality teaching patterns. Various people have different styles of learning. On one hand, where some prefer to learn via reading, others on the other hand, prefer to listen or visualize or they may take multiple ways of grasping and thus, learning.

There are a handful of key points which add value to the learning behaviour of the learners such as self-confidence, encouragement, visualisation, learning capabilities and so on. It also includes the process of involving ICT into learning based on personal experience.
1.1 LEARNING

1.1.1 Concept of Learning

Learning can be generally explained as a process in which an individual acquires knowledge, memorizes it and make use of it in making his/her life easier. Learning may happen in either of the two forms: consciously or unconsciously. Unconscious learning can be exemplified by first time balancing a bicycle. On the other hand, learning in the classroom is an example of learning while being conscious. A number of methodologies are being followed in order to make learning more apprehensive such as relating things with real life, taking examples, simulating learning, learning by audio-visual experience, learning with the help of undergoing a particular experience and so on. For example some individual may want to watch a documentary based on the European history whereas others may want to read about it and make notes and then learn it. As such no technique can be in particular termed as right or wrong. It depends upon the individual how he/she may perceive it.

Each individual has a unique style of grasping and picking up the things and retaining these things in the memory and thus, learning by their own capabilities and methods. Since, there are a large number of learning techniques and methods therefore, any individual can take up or may consider any way or method suiting one’s own will and thus, leading to the best outcome. A good learner is one who knows the right methods of learning in accordance to his/her abilities in order to produce the best results in real life situations and apply this knowledge righteously. We all know that the experience of an exactly same instance can largely vary among different individuals not only because the different angles that particular instance is taken up to or because it occurs at different life situation for every individual, but also due to the immense variation in the personality and motivations of each individual.

Salovaara in [1] rightly states that self-confidence plays a very vital role in the learning process and abilities of any individual. The fact holds immense importance that self-confidence builds the individual and it is extremely important that an individual understands his/her learning capabilities and the requirements to feed this learning with supplements and; without appropriate self-confidence it is very hard to
develop such a sense about learning. The speed and pace of learning may also vary among varied individuals. There are cases when learners are at ease with the pace at which the universities deliver education and there are cases where individuals may not even be comfortable with the pace of elementary school education.

1.1.2 Learning Theories

Many theories are accountable for various learning styles and methodologies. Learning theories can be considered as models to many individuals who look upon these theories for evaluating their own sense of belonging with their learning and, formulate newer ways in accordance with their ease of learning a particular subject. Basically, two major theories have evolved so far which have other theories as their sub-divisions. Before 1960’s, it was the behaviour that lead to the evolution of various learning theories. It influenced the methods of teaching in a wide sense. Learning based on behaviour has certain principles such as recognizing goals and developing strategies to achieve them, establishing components of evaluation based on the relations with these defined goals and systematically proceeding with preplanning.

After 1960’s, such theories were overtaken by constructive theories. Constructive theories throw light on the psychology of human conscience and are based on the thinking processes, memory of individuals, memorizing capabilities and so on. Constructivism is based on gathering information by the individuals based on the experience undergone by every individual which is then analyzed and processed by every particular individual using their own interpretations. Such type of learning centres around the learner and is self-regulating. These principles of constructivism are extremely effective in the distance learning programs as well as in the independent learning.

A constructive approach in the process of learning aims at bringing up of a sense of better learning environment. Such learning process lays emphasis on the mental empowerment and creativity of individuals. Empirical learning was what encouraged the growth of human psyche. Adult education makes great use of it and it is highly apt in imparting the righteous education to different individuals. This view also perceives
the experience that the individual would undergo throughout the process. Stressing only on the experience is not enough but there are a number of other pre-requisites too. Psychologist Howard Gardener established a theory based on human intelligence. He formulated the theory which stated that there were at least a total of seven sorts of “intelligences”. He defined these intelligences as a well-derived set of skills which help an individual to deal efficiently with the problems that one face in his/her life. They are mentioned and explained briefly as following [2]:

1 Body-Kinesthetic: the ability of body to control motion and physicality along with the esthetics of physical wisdom.
2 Verbal-Linguistic: such ability is defined with the proper usage of words and language.
3 Intrapersonal: this particular ability defines the inner-being or self-conscience of the body. It relates with the spiritual being within us and the awareness about ourselves.
4 Visual-spatial: it is defined as the ability to visualize knowledge and objects and the spatial dimensions present in the scenario.
5 Interpersonal: the ability to recognize and deal with relationships and communicate from person-to-person.
6 Logical Mathematical: this ability defines the ability of an individual to recognize and understand the existence of pattern formation and deal with numbers and calculations with an approach of inductive as well as deductive thinking.
7 Internal view of pictures and images.

According to Gardener’s view, the main focus of education revolved around mathematical intelligence and the linguistic approach. However, he also emphasized upon the importance of other subjects as well besides academics which are equally responsible in the growth and development of the individual. He suggested that teachers must also pay attention to the abilities of the students who were good in multimedia, dance/music, arts and so on.
1.1.3 Distance Learning

This type of education is a result of the fact that such learning is acquired when the teacher and the student are not present at the same place during the course but are in contact with one another through some means of media. Distance learning comprises four types. The first type of distance learning prevailed from the ancient times since the 19th century where this type of learning was relevant through the form of hand written letters to qualify for correspondence education. It had many drawbacks including lack of interaction and as such, the process was extremely slow and time taking.

Second form of distance learning was introduced with the emergence of the new technology where radios and televisions were brought into our life. They helped in imparting education and thus, learning. The only loophole in this learning was that it was a one way channel where the students were mere listeners and thus, no interaction could be made. This scenario got changed when some newer technology came into existence to largely transform our lives. This type of learning was enhanced by telephones, emails, video calling and similar mass media. This enabled two-way communication and thus, made distance learning easier and more comprehensive than ever.

Today, we are in the world of forth generation distance learning which is running on the concept of online learning. This type of imparting learning has made Information and Communication Technology i.e. ICT go viral and even mandatory in our lives today. The establishment of the information network combined with the multimedia has led to the emergence of the term Virtual Learning Environment (VLE).

1.2 ONLINE LEARNING

1.2.1 Concept of Online Learning

The backbone of online learning is some sort of a network. This network can be that of an Internet or just an internal network of some institution accessible to only its students for imparting them the required education. According to Ally [3], online learning can become to be known by any of the following names such as: tele-
learning, e-learning, distributed learning, computer-assisted learning, Internet learning, web-based learning, virtual learning or distance learning. This sort of learning is required when the learner is at a distance from the teacher and the learner has to have access to some sort of media to acquire the learning material. Ally also classified the online learning to be accessible through the following three classes [3]:

1. Learning through keeping in touch with the internal network of the particular institution.
3. Self-study done through Internet or at any other particular network.

The first class out of these have the learning material available on the network and only the lectures are delivered directly through some means of communication. The second class of this learning is the one in which multiple ways are used such as participating in the discussion forums, e-books and material available on internet, or tuition of the subject from some tutor. The third type of learning has a virtual environment around the learner where he/she may not be granted any help from outside. Online learning may not facilitate the one-on-one interaction of the student and the teacher and the study material is accessible through the network only but e-learning today has largely impacted the current scenario of education. E-learning is that form of learning where a student has to contribute to his/her learning on a greater level by setting his/her own standards and being regular. The teacher-student relation in this modern era is not supported by the traditional method of imparting education. Therefore, the name stands righteously as e-learning and not e-teaching considering the learners’ contribution.

Comparing such type of learning with the traditional learning, e-learning is much more difficult not just for the student but also for the teacher as well. The teacher has to prepare the study material and make it available on the network prior to the start of the classes. Also, at the same time, the students or the learners have to go through the difficulties of accessing the material, understanding it on their own and learning it along with the pressures of the normal classroom teaching. The teacher and the learner have to put extra efforts into virtual learning environment in order to make it
an integral part of their learning curriculum. It is also mandatory for the teachers to keep a regular check on the study material and update it on time at periodic intervals. This will ensure that the updated material is of good quality and matches the standards of teaching and is relevant to the subject.

Going by the scenario of professional education, e-learning has formed an integral part of the development of learning techniques along with virtual learning environment. Though, there is an influx of new technologies to enhance different methodologies of learning but as of now, these new technologies have not been used very efficiently and deliberately in the process of learning. This is due to the traditional system of teaching and learning still prevails largely in the scenario and the process of imparting education is largely dependent on this traditional system. Hence, pulling back this system on a short notice may not produce the desirable results. As a matter of fact, online learning has been taken up only to ensure that the virtual environment of learning proves to be helpful in raising the learning standards of the students and that it aligns with the comfort levels of the students as well the teachers.

On one hand, where all the young ones are being influenced by the influx of the new technological era of learning, there still exists a lack of methodologies to have an accurate say on the quantitative measures on how greatly these are helpful in imparting education. The irony of the situation is that we may find many forms of study material on the Internet supporting various fields of humanities but without qualitative controls.

1.2.2 Self-Learning on the Network

Self-learning widens up the horizons of learning for the learner as it gives him/her a brighter opportunity to time his/her studies and opens a better scope of gathering knowledge from various open sources. This also means that it is not just the teacher who is responsible in bringing the material to the student but the learner himself can help and formulate methods of his own learning. This also enhances the responsibility of the learner for whom the right form of time management is also very necessary in order to ensure that he/she is not left behind in the academics and the pace of learning.
is absolutely correct. A good learning environment and impactful material with interesting content for learning can boost the interest of the learner to look for even more matter available on the Internet to broaden up his/her horizons. It is also important for the learner to refine his/her own skills of learning and understand the patterns of learning to establish his own set of notes and material based on the understanding. The environment should be motivational for the sake of better understanding and thus, learning. Also, the learning material should be easily available and must include proper illustrative examples and applications of the subject in order to make it easier for the student to co-relate concepts to real examples.

Teachers, in such scenarios, play a vital role in imparting the correct form of education and also in boosting the students to learn further. Although, e-learning does not facilitate the one-on-one interaction of the students and the teachers but it does not imply that the entire contact is missing. At times, the teachers acts as a motivator too. Also it is the teacher only who tests the learning capabilities of the student and facilitates the feedbacks.

Thus, it’s a wrong notion to believe that the responsibility of the teacher decreases in distance learning. And it is also incorrect to believe that students have a greater amount of free time when they are not required to attend to the lectures in a classroom. Rather, teachers have an equal amount stress and workload in order to keep a check on the on-going process of imparting the righteous education. The creation of the study material prior to everything and uploading it on the network and making sure that it is the most correct material is in itself a tedious task. Assuming that the job of the teacher is over once the material is uploaded would also be a short sight. The teacher has to further study the subject and participate in all forms of communication with the student in order to maintain the quality. Also, the updating of the material, to be in regular touch with the latest developments in the subject concerned and any changes made to it and then updating the material accordingly is in itself a tough task to do and leads to a lot of workload and stress.
1.2.3 Strengths and Weaknesses of Online Learning

The biggest advantage of online learning is that learners have the access to the learning material at any point of time regardless of any barrier of space and can study their material whenever they want with no bars of place and time. Say for an example if the teacher is in Delhi and the learners are spread all around the world, so at any point of time, any learner can access the course material uploaded on the network by the teacher and any student can have the access to it through the facility of Internet.

The greatest benefit of learning online is that the subject of the study is not just limited to the course material available on the network but since, Internet is such a wide repository of knowledge and is equally accessible to all, thus, learners can interact with one another on the network and can share ideas as well as resources amongst each other. In this sense, e-learning is extremely potential as it opens platforms like e-learning portals where learners can not only interact with learners belonging to various places who can put their heads together in discussion forums but also with various, experts, instructors and teachers. Interaction is something which is brought up by the network itself.

One major issue that online learning has to face today is target-oriented learning. It is tedious and learners may not be able to match the pace in the given duration of time of a specified target. The need of the hour is to change the mind-set of the learners and it is important to imbibe into them the thought of extracting knowledge in a time bound manner not just from mere study material or from sources on Internet but also through interaction with people as an equivalent source of imparting knowledge.

Due to the emergence of the new gadgets and gizmos and all the technology, technology has comfortably synchronised with the lives of the people in the developed nations and thus, they are at an ease of adapting to the tracks of technology into their societies as well. The scenario in the less-developed countries is different since these countries do not have enough access to Internet and computing devices population. Hence, these nations are struggling to keep the pace of e-learning in their day-to-day lives as of now. Moreover, on the other hand, if somebody has the access to Internet and thus, online learning, he/she may not have sufficient knowledge or
skills to operate and facilitate it. One major drawback of such type of learning can also be regarded as the fact that technology is not completely reliable as of now.

Online learning throws as a big burden of responsibilities on the shoulders of learners because each learner himself/herself is responsible for the outcome of his/her studies. With online learning, since there is no watch or check of any authority or restrictions of time and space on the learners, there might be a great possibility that a callous attitude may result in lagging behind of the pace of the learner and the very purpose of e-learning gets defeated.

It is important for the teacher that he/she must pay attention to ways in which the callousness of the learners can be compensated and boost their motivation from time and again that the learner must feel the urge to be regular and updated with his/her lessons. Or else, it might cause a gap between the learner and the teacher. There are other forms of distractions as well and the fact is that the online learning environment along with Internet in itself can become big source of distraction for the learners. In discussion forums of relatively large groups, the interaction opportunities per learner can lessen to a great extent. Online learning is not suitable for some sorts of education for example, teaching surgical methods, public speaking or sports where the performing practicals are mandatory. Also, the sudden change of traditional classroom teaching method into virtual one and transforming the courses into online teachings is somewhat a tedious task and the adaptability level to it on sudden changes might not produce desirable results or would enhance the quality for that matter. One major drawback is that usually, the availability of qualified professionals to develop distance education material and planning the entire scenario is overlooked.

1.2.4 Web Course

A course which is imparted to the students with the help of the web technology is known as web course or online learning. It may be completely based on the web itself or can be based on computer setting or text. It is involves the following steps:

1. Pre-planning and selection of the subject
2. Participation at every level
3. Formation of proper conceptual learning  
4. Following the instructions properly and delivering feedbacks regularly  
5. Paying proper attention, perceiving and recalling

1.2.4.1 Quality of a Web Course

Illinois mentioned a number of standards to state the quality of a web course based primarily on the structure and aims of the web course [4]. It can be mentioned here that it is also important to make sure the study material is easily accessible and also easily understood and must also to be interesting to follow. The points which are mandatory to focus on:

(a) the format of the course should be laid down clearly  
(b) the study material should be arranged in a simple and easy to understand way  
(c) the presentation should be made in such a way that it makes the learning comprehensive and interesting

It is important to make sure that the instructions given to the learners are laid down clearly with highlighting the critical points. The discussion forums should be entertained on 24X7 basis in order to take queries of the learners at any time as per the ease of the learner. This enhances the quality of the web course. Also, it is important that the web course provides links of some effective audio-visual resources apart from the learning material in order to provide a better scope of understanding to the learners. Also, it is important for the learners as well to always remain in high spirits focused and motivated in setting their goals straight and follow their studies regularly. Also the teacher must also continuously encourage the students so as to boost their moral. He/she should be able to make the students comfortable to a level that they themselves feel motivated to discuss any sort of doubts or queries with the teacher. Various processes of the web courses must be interesting, easily accessible and easy to understand. The teaching equipments used should be of great quality and also suitable for the course.
One prime point of importance is that the study material is accessible at any point of time regardless of the number of students accessing it. Otherwise the students may feel demotivated and may find the learning not so convenient. Teacher’s feedback should be quick and desirable and must be helpful to the learners. This would help students in self-evaluation of their learning process and encourage them to generate their own performance scales to evaluate themselves. Proper guidance should be available to the students and the course material should be easily accessible as well as easy to use.

1.2.5 Teaching, Instructing and Evaluation in Online Learning

The problem with online learning is that the interaction between the teacher and the learner is generally delayed due to a number of reasons. Online learning opens the platform for hypermedia objects which tend to replace the jobs of the routine deeds of the teacher and teachers have to prepare the entire course hand-out beforehand [5]. Many a time, the teachers themselves feel the prerequisite knowledge of ICT skills overshadow the contents of learning and it has to integrated into online learning even if it does not fit so well. There is also a need to appoint professionals for the training of the teachers to help them understand the integration of information and technology with their skills of teaching and thus, for a better implementation for the student [6].

As far as the roles of teachers are concerned. Fahy in [7] has proposed five roles for them. One of those major roles is providing motivation to the students which is sometimes missing due to the absence of the traditional system of teaching and online is an environment where the boost for the learners is extremely important. Teachers should give them challenging tasks so that they can utilize their skills and enhance them. Not just this, the material uploaded by the teachers on the network should be in accordance with the latest trends, should be interesting and at the same time, easy to grasp. The teacher must also encourage the learners to participate in all sorts of discussion forums and must maintain some sort of social contact. Next important role of the teacher is that of an organizer. Since, it is the teacher on whom the entire study material is largely dependent.
It is important for the teacher to organize various means to provide solutions to the problems that the learners might face. Also, applications must be developed by the teachers in order to allocate space for the challenges that might be posed to the learners while learning. Another important role of the teacher which acts as a strong pillar to fill the gap of distance between the learner and the teacher can be that of a communicator. Communication can be effected through emails, discussion forums, chat-groups and so on. It must be mandatory for the teacher to be extremely active on these groups and to nurture the learners with proper guidance and support. Right guidance can lead the learners to better understanding and by minimizing their problems and making them excel in their academic curriculum as well as on social front.

The other necessary ingredients for online learning are motivation boosters, self-steering atmosphere and a positive attitude. This also results in different evaluation techniques. It is obvious to notify that since, the teacher and the learner are never expected to meet, this requires a set of varied evaluation techniques altogether. Therefore, new methods of evaluation must be formulated for judging the results of the entire course and thus, traditional methods of questionnaire, quizzes cannot be used here.

1.3 LEARNING STYLES

The style of learning can be judged and recognized by going into the psyche of the student of learner and as far as the student is concerned, it is important for the students as well to self-introspect the study patterns that suits his/her learning. Learners tend to accumulate interest for some sort of learning pattern and prefer a specific preference of teaching pattern over others.

1.3.1 Introduction to Learning Styles

There is no specific fine line drawn over the learning styles. A student may prefer a specific learning style over other styles but also use some techniques of learning from other styles as well here and there. A learner may combine two or many methods of learning and then use the most suitable technique from each style. It is important to
notify that how students perceive each learning style and what benefit can a student draw from each of them. It is rightly stated by Coffield et al. [8] that as for a student it is mandatory to judge the weaknesses of the student and work on them in order to overpower these weaknesses and turn them into his strengths. It is used to enhance the awareness amongst the students and recognize their meta level of learning. Also, it is suggested by Merrill [9] that if students are left alone in order for them to find out their own comfort learning patterns, they might not be introduced to new learning styles and will never be able to learn new patterns. Coffield et al. [8] also mentions about the students who are under-confident, that it is interesting to motivate them to explore their learning pattern and it will be interesting to observe these students as they may bring up new teaching methods for the learners. Graf [10] states that e-learning is a software which leads to system sharing thus, idea sharing among students of the same interest targeting a common goal of learning and together they can observe new patterns of learning with their core assets.

1.4 LEARNING STYLE QUESTIONNAIRES
Every learning style comes with its method of evaluation in some or the other way. These evaluation methods not just judge the results based on pure academics but also judge the attitude, mind-set, behaviour and perceptions in general. Each learning style belongs to the developer and has its drawbacks too. Nobody should take it very firmly and tag his/her learning style but be flexible to accept changes in order to account for better outcomes. Coffield et al. has formulated 71 in total learning styles out of which 60 have their own methods of evaluation which are categorised under the following:

1. Stable concentration while learning.
2. The strategies formulated and approaches considered for a better learning environment.
3. Preference of stable learning
4. Style of cognition
5. The general visual-auditory-kinesthetic-tactile (VAKT) or the habitual inherent style.
The division of learning styles in the previous five families is shown in Table 1.1

1. Genetic and other traditional learning styles and preferences including the four modalities Visual-Auditory-Kinesthetic-Tactile (VAKT):

<table>
<thead>
<tr>
<th>AUTHOR(S)</th>
<th>ASSESSMENT TOOL</th>
<th>YEAR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dunn and Dunn</td>
<td>Learning Style Questionnaire (LSQ)</td>
<td>1979</td>
</tr>
<tr>
<td>Gregorc</td>
<td>Gregorc Mind Styles Delineator (MSD)</td>
<td>1977</td>
</tr>
</tbody>
</table>

2. Cognitive Structure:

<table>
<thead>
<tr>
<th></th>
<th>ASSESSMENT TOOL</th>
<th>YEAR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Riding</td>
<td>Cognitive Styles Analysis (CSA)</td>
<td>1991</td>
</tr>
</tbody>
</table>

3. Stable Personality Type:

<table>
<thead>
<tr>
<th></th>
<th>ASSESSMENT TOOL</th>
<th>YEAR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Apter</td>
<td>Motivational Style Profile (MSP)</td>
<td>1998</td>
</tr>
<tr>
<td>Jackson</td>
<td>Learning Style Profiler (LSP)</td>
<td>2002</td>
</tr>
<tr>
<td>Mycrs-Briggs</td>
<td>Mycrs-Briggs Typc Indicator (MBTI)</td>
<td>1962</td>
</tr>
</tbody>
</table>

4. Flexibly Stable Learning Preferences:

<table>
<thead>
<tr>
<th>AUTHOR(S)</th>
<th>ASSESSMENT TOOL</th>
<th>YEAR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Allison and Hayes Hermann</td>
<td>Cognitive Style Index (CSI)</td>
<td>1996</td>
</tr>
<tr>
<td></td>
<td>Brain Dominance Instrument (HBDI)</td>
<td>1995</td>
</tr>
<tr>
<td>Honey and Mumford</td>
<td>Learning Styles Questionnaire (LSQ)</td>
<td>1982</td>
</tr>
<tr>
<td>Felder and Silverman</td>
<td>Index of Learning Styles (ILS)</td>
<td>1996</td>
</tr>
<tr>
<td>Kolb</td>
<td>Learning Style Inventory (LSI)</td>
<td>1976</td>
</tr>
<tr>
<td></td>
<td>LSI Version 3</td>
<td>1999</td>
</tr>
</tbody>
</table>

5. Learning Approaches and Strategies:

<table>
<thead>
<tr>
<th>AUTHOR(S)</th>
<th>ASSESSMENT TOOL</th>
<th>YEAR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Entwistle</td>
<td>Approaches to Study Inventory (ASI)</td>
<td>1979</td>
</tr>
<tr>
<td></td>
<td>Revised Approaches to Study Inventory (RASI)</td>
<td>1995</td>
</tr>
<tr>
<td></td>
<td>Approaches and Study Skills Inventory for Students (ASSIST)</td>
<td>2000</td>
</tr>
<tr>
<td>Stemberg</td>
<td>Thinking Styles</td>
<td>1998</td>
</tr>
<tr>
<td>Vermunt</td>
<td>Inventory of Learning Styles (ILS)</td>
<td>1996</td>
</tr>
</tbody>
</table>

Table 1.1: Families of Learning Styles [8]
The Myers-Briggs Type Indicator (MBTI) is a type of questionnaire in which students are asked to answer questions based on their agreement. They are supposed to rate these questions on a scale of 5 on a Likert scale. Another method to evaluate and observe the pattern of learning of the students is by The Kolb’s Learning Style Inventory (LSI) where students are given 12 sentences with blanks. These sentences are supposed to be ending with any of the four given choices. It depends upon the student how he/she may perceive each sentence and select the choice to fill the blank up. Felder and Silverman in [11] another method called the Index of Learning Style (ILS) in which students were judged on a range between -11 to +11 where students are supposed to answer 11 questions and the results are evaluated on the basis of the answers of these 11 questions [10].

In all 13 ways of learning have been formulated and demonstrated by individual researchers [8] which when combined together form the foundation of the research to establish the entire theory of the learning and designing instruments for further demonstration which must have the features of consistency, validity on a predictable note and test-reliability. Researchers who came closer to achieving these standards of model were Allison & Hayes, Apter, and Vermunt. Whereas researchers like Entwistle, Herrmann and Myers-Briggs met half of the standards. A new model called the Jackson Model came to influence the market but ever since, no evaluations have been conducted based on this method. The other models could not even meet the bare minimum of the criteria and thus, failed. The conclusion that was drawn out was as follows:

Some best known instruments of evaluation being used at the time in the research have some serious loopholes such as non-reliability, high failure rate and so on and thus, it is strongly recommended that the use of these tools shall be discontinued.

The model developed by Allison and Hayes has been acclaimed critically and has largely been used in business and more by the teachers and managers than by the students as learners. Their model named as the Cognitive Style Index (CSI) is said to have the best psychometric credentials. Another important aid is Entwistle’s Approaches and Study Skills Inventory for Students (ASSIST) which is helping in
formulating skills of teaching as well learning in such a scenario in designing methods of assessments and refined curriculums. Another model named as the Vermunt’s Inventory of Learning Styles (ILS) suggested by Coffield et al. has been proving its mettle in helping not just the learners but also the staff members in assessing the methods skilfully and cognitively with validity.

1.5 LEARNING STYLE MODELS

We already know for a fact that there exists a number of learning models to be applied for varied styles of learning. This particular section of the research mentions mainly about four types of such models. These models throw light upon three major aspects of humans i.e. visual, auditory and feeling. It is called the VAK model. But above all, the best model considered is the Kolb’s Learning Style Model. We will also be throwing light briefly on the Honey and Mumford's Learning Style Model and The Felder-Silverman model.

1.5.1 VAK Learning Style Model [8]

As the name suggests, this model is based on the general notions of human ideology and perception. Learners are observed from these skills. They are majorly of four types: visual, auditory, kinaesthetic and tactile. This model is not exactly a pattern of learning or is not developed by anyone for those matters. This model forms the foundation of many models and provides the basic ideology behind the each learning pattern giving rise to a number of other models. Many models are based on it such as Dunn and Dunn Learning Style Model, Gregorc’s Mind Styles Model and Style Delineator Model.

Learners who learn though visual measures such as by seeing pictures, notes, or watching documentaries learn fast through their visual senses. Reading is a very useful form of learning for such learners. They also tend to learn from mind-maps and tables. For them, their eye-sight is a very sharp and important aspect.

Students who have good auditory senses find it very easy to integrate themselves into virtual learning. By listening to virtual lectures online, video/audio clips, audio
discussion forums and so on. Such learners concentrate on each detail and learn one thing at a time. For kinaesthetic learners who learn through experimenting and then believing have difficulties in virtual learning since, they believe a lot in their insights and feelings, and they make sure that everything they perceive comes through the kinaesthetic senses.

<table>
<thead>
<tr>
<th>Learning Style</th>
<th>Prefers in Learning</th>
<th>Recommended e-Learning Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Visual, Verbal</td>
<td>Text</td>
<td>e-Books, lecture notes, articles</td>
</tr>
<tr>
<td>Visual, non-verbal</td>
<td>Graphics, Tables</td>
<td>Figures, charts, tables, map, videos, animation</td>
</tr>
<tr>
<td>Auditory</td>
<td>Sound</td>
<td>Group works, virtual lectures, sound samples, video conferences.</td>
</tr>
<tr>
<td>Kinesthetic</td>
<td>Practical related things</td>
<td>3D-models, hands-on tests with specific programs.</td>
</tr>
</tbody>
</table>

Table 1.2: VAK Learning Styles in e-Learning

The given figure shows how effective is VAK model in for online learning. For the sake of visual and verbal learning, lecture notes, e-books and articles are recommended as sufficient for learners who learn through this particular aspect of the model. As far as visual and non-verbal learning is concerned, figures and facts along with maps, videos and graphical tables are taken into account. As for the auditory account is taken by far, what is most effective is virtual lectures, sound samples, video conferences and group work as of whole. Kinesthetic learning involves hands-on tests, 3D-models with some specified programs to volunteer.

1.5.2 Kolb’s Learning Style Model [8]

Inspired from the works of various famous contemporary research analysts like Rogers, Jung, and Piaget, according to Coffield, Kolb developed his own theories as a result of many years of hard work and research into this subject. He in his book *Experiential Learning: Experience as the Source of Learning and Development* (1984), suggested various reforms and strategies to overcome the challenges faced in
online learning for the learners. He also developed and gave away many theories such as Kolb’s Experiential Learning Theory (ELT) and Kolb’s Learning Styles Inventory (LSI). He described four distinguished categories of learning which are as follows:

1. Doing - Active Experimentation (AE)
2. Thinking - Abstract Conceptualization (AC)
3. Watching - Reflective Observation (RO)
4. Feeling - Concrete Experience (CE)

![Figure 1.1: Kolb's Learning Styles and Cycle](image)

Kolb has described his model in the form of a cycle. He explains that the process starts from a certain vibe of experience. From there, it moves ahead towards observing the formation of some sort of pattern in order to enhance the view of the subject. After that, it moves further looking upon conceptualising the entire format for a better understanding. It then, finally converges to experimentation where the real results are drawn.

Following are the categories of the leads of the cycle:

- Diverging (CE/RO)
- Assimilating (RO/AC)
- Converging (AC/AE)
- Accommodating (AE/CE)

There are one set of people who are known as the diverging creed. This set of people tends to learn mostly by watching [12]. They have a wishful sight for watching and thus, observing the scenario and grasp accordingly. They generally believe in working in teams and collect information from a number of sources. They like to receive personal feedback and use the wits of their imaginary power to find solutions to their problems. As it was suggested by Smith and David in [13], such learners tend to have a mixture of watching and observing the studies closely and come to conclusions only if their will is satisfied. Assimilate is defined as observation [12]. Such people have a rational view and believe their gut feeling and ideas rather than people. They tend to observe things on their own level and come to various inferences. They like to analyse first and then believe, and generally like logical theories.

Another set of theory is about converging set of people. They believe in the practicality of the situation and combine their thoughts with it. Neither are they very close to social relationships or people for that matter. They are more inclined towards technical tasks. Converging set of people believe in performing practicals and then evaluating any logical conclusion to develop some sort of application.

Another set of learning style is that of accommodating. In this particular style, people like to learn through feeling first and then integrating their feeling into their deeds and actions. Accommodation basically refers to adaptability. They learn things in accordance with the highlights and thus, believe on the firmness of the institution of their beliefs rather than stressing upon logic. Even they prefer groups to complete the tasks.

### 1.5.3 Honey and Mumford Learning Style Model [8]

This model has its foundation stone laid down by Kolb’s model. It has four key points:
They differ somewhat from that of the learning strategies developed by Kolb. As we all know, that we all learn when we undergo some sort of experience, it may be a problem or an opportunity. But the best is drawn through an experience in terms of learning. Activists are those people that comprise the set who do not want to be under any sort of pressure of restrictions or rules and regulations. They like to learn new things with fun-filled methods and learning through lectures is not their cup of tea [14].

Reflectors are those set of people who like to take a leap from the entire situation and go into a self-introspection mode after observing the entire situation and give their own thoughts to what is happening. They do deeper studies by analysing and preparing feedbacks. They are not leaders neither do they like to do things with deadlines.

It’s the theorists who keep aside emotions and like to think rationally and logically. They like to be in tough situation where they are posed with extreme challenges in order to use their wits and knowledge to solve problems. They like to work in environment which is more structured and detailed and believe in formulating everything based on concepts.

Pragmatists are that set of people who would learn in situations where there are proper guidelines and when there is some fruitful benefit to draw. They believe in presentation and are far-sighted. They believe in hands-on practices while doing their job.

Thus, it can be concluded that this model is very similar to kolb’s model in the following sense:

- Activist = Accommodating
- Reflector = Diverging
- Theorist = Assimilating
- Pragmatist = Converging

<table>
<thead>
<tr>
<th>Learning Style</th>
<th>Needs in e-Learning</th>
<th>Recommended e-Learning Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Activist</td>
<td>Interaction with other students free from exploration and observation, no strict schedules</td>
<td>Group works, experimental problem-solving, real-time conversation</td>
</tr>
<tr>
<td>Reflector</td>
<td>Organized studying methods, well outlined lectures, systematic instructions</td>
<td>e-books, forum conversation</td>
</tr>
<tr>
<td>Theorist</td>
<td>Traditional learning, clearly defined goals, well prepared exercises, tests, measuring learning</td>
<td>Assignments: Case study or logical cause-effect, online presentations, problems and quizzes during the course</td>
</tr>
<tr>
<td>Pragmatist</td>
<td>Experimental possibilities</td>
<td>Practical exercise, real-time conversation</td>
</tr>
</tbody>
</table>

Table 1.3: Honey and Mumford Learning Styles in e-Learning [8]

1.5.3.1 Website Organization According to Kolb’s Model [8]

According to University of Minnesota, online learning on the website is a boon to the students who have access to the network. They believe that a good website is the one which follows Kolb’s model. In accordance with the website, a learning network must provide four basic resources as elementary to the development of an efficiently helpful and skilful website which are: notes of lectures, maps highlighting concepts, solving quiz with the light of simultaneous results, links of videos, discussion forum’s links, guides and links of workshops and so on. The website must comprise of the following features:

- A book acting as a guide which not only throw light on the text but also
adds practice questions after each section

- It’s worth to share a story with moral that describes some life event of any famous personality full of inspiration and encouragement.
- Posting assignments with deadlines can be beneficial. Also, in order to boost the confidence of the students/learners, some extra credit should be given to the outstanding work as a reward and token of appreciation.
- Preplanning is an extremely integral part of this course. It can reflect upon the flaws beforehand which can be corrected according to the scenario.
- Including video clips, add fun part of the text and thus, refreshes the mind of the learner.

Designing website according to the clauses mentioned above can prove to be extremely helpful for the students and they will also have a chance to choose the learning option among the choices suiting their own style or pattern of learning.

1.5.4 Felder-Silverman Model [8]

Richard Felder and Linda Silverman in 1988 proposed the Felder-Silverman Learning Style Model (FSLSM). It basically takes up its concept of learning and growth from the learning patterns of the students pursuing engineering. Earlier, the engineering students used to have five patterns of learning which were later reduced to four. They are as follows:

- Active/Reflective
- Sensory/Intuitive
- Visual/Verbal
- Sequential/Global

Sensory learners refer to those who learn by the given facts and tend to solve the problems based on their previous knowledge. Intuitive learners, on the other hand, tend to find out the probability of the possible outcomes. Visual learners are those who believe in their sight senses and learn through visualizing whereas verbal learners are those who learn by reading text. Active learners will believe in adventure and
exploring something new to learn whereas reflective learners will be the one who will always learn through things which already belong to them. On one hand where sequential learners believe in step-by-step learning, global learners will prefer to understand big chunks in one go.

<table>
<thead>
<tr>
<th>Learning style</th>
<th>Recommendations in Learning and VLE</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Active</strong></td>
<td>printing material, chat groups, discussion forums, texts, mind-mapping, arrows guiding directions to study. Solving puzzles, working along others, guessing answers to raised questions, integrating with everyone.</td>
</tr>
<tr>
<td><strong>Reflective</strong></td>
<td>listening to story based learning, watching documentaries for better understanding, writing notes on learnt material for better learning, focusing on the aim of the study, taking help from internet to deeply enhance the knowledge for the subject.</td>
</tr>
<tr>
<td><strong>Sensing</strong></td>
<td>more focused on the reasoning behind each matter of state, finding factual data about the subject, rationalising each subject by raising questions of why and how, relating texts and learned knowledge with real life situations and applying them for a better perspective. Digital movies, media clips, audio objects, slideshows, digital library, media texts, case studies etc.</td>
</tr>
<tr>
<td><strong>Intuitive</strong></td>
<td>letting students interpret the texts in accordance with their own will, making them put their innovation and imagination in their learning to widen up their horizons and scope of ideology. By idealising their concepts and theories. Multimedia, digital movies, lesson objectives, graphics, audio objects and linear text.</td>
</tr>
<tr>
<td><strong>Visual</strong></td>
<td>conceptual maps, hypertext, text-based material, animations, images, flow charts, colour notes, tables, highlighters, case studies, slideshows etc.</td>
</tr>
<tr>
<td><strong>Verbal</strong></td>
<td>attending and participating group discussions, interacting in lectures, videos, text-based material, conceptual maps, hypertext, writing summaries of the learned objects etc.</td>
</tr>
<tr>
<td><strong>Sequential</strong></td>
<td>a predefined track guided by someone or sort of inspiration</td>
</tr>
</tbody>
</table>
throwing light on the aspirations of such people.

**Global** open course structure, media objects slideshow etc.

### Table 1.4: Recommended Activities in VLE According to the FSLSM

Since active learners always need something confined to be going on so discussion forums and other such activities are a big yes for them. They like to learn through material which provides a boost to their learning system. Reflective learners generally tend to put themselves into the situation itself and try to co-relate them to whatever they learning in whichever way it is possible. They like to learn something which defines their own reflection about it. Thus, making them watch documentaries and attend motivational sessions will also help. Learners who are into sensing are deeply immersed into their thinking process. They need to have a deep realization of the stuff they are learning sensing each way. Intuitive learners tend to connect themselves in every possible way and have a push to inspire them to move ahead absorbing everything into them in one go. They like to motivated and learn best when are motivated. Thus, there ideals need to look upon deeply and therefore, such object-oriented learning is mandatory for them. Visual learners register everything they see and wish to learn in their sight and thus, in their mind and memorise everything by keeping a clear sight full focus on the subject. Thus, showing them everything that will attract their attention will be helpful in making them learn efficiently. Verbal learners believe in maximum communication verbally through which they not just interact in the learning sessions but also actively participate in doubt clearing due to their confidence of speaking. They understand the best when described in a good way of communication. Thus, the objects of learning suggested for them are conceptual maps and text based learning material. Sequential learners are those who follow the on-going pattern and step by step methods of learning. Global learners are those who welcome any and every sort of learning methodology. They comprise all the above mentioned groups.

Computer based learning prefer the Felder-Silverman Learning Style Model (FSLSM) as the most convenient and appropriate [15]. Index of Learning Styles (ILS) is an
assessment module created by this model which briefly intact all the prerequisites. Such methodology is based on questionnaires consisting of 44 items and follows the -11 to +11 system [16][10].

1.6 LEARNING STYLES IN E-LEARNING

Figure 1.2: Learning Styles in e-Learning Environment

Manochehr in [17] tried to compare and contrast the trends of e-learning with that of tradition system of learning. He experimented with various techniques on the basis of the student’s learning styles and their absorption of knowledge in each methodology. He has argued that the system of traditional learning is not as effective as that of e-learning. He also emphasised that converging learners tend to do better learning while doing it through e-learning. Graf and Kinshuk [18] have seconded the point by experimenting various preferences of the learners and analysing there pattern of learning in which they found out that students referring e-learning have a better scope of grasping wider knowledge. According to Felder-Silverman Learning Style Model
(FSLSM), reflective learners tend to learn faster with the help of examples as compared to active learners. Active learners tend to emphasize more on studies based on facts and figures. Sensing learners tend to go through the study material again and again and revise it several times while also solving assignments as compared to intuitive learners. On one hand where sequential learners go through the minutest detail of each chapter of the study material and tend to start from the beginning following to the end, on the other hand, global learners skip the memorising part and tend to go through the overview again and again.

The figure above shows the various learning patterns of the learners. Firstly, a question is being put up of whose answer helps in determining what sort of learner that person is and which learning style he/she may follow. If the learner finds the result of the analysing test inappropriate, the test can be re-conducted. As the test is conducted and the inference about the learning pattern of the learner is made, he/she may pick the learning objectives and helpful material from the learning environment. The teacher must provide a variety of learning material that satiates each learner’s requirements and boosts his/her learning abilities. A wide scope of learning styles should be followed and while making assignments and questionnaires these learning styles should be taken in account in order to develop a common insight for all the young learners as it might fit them all.

A number of activities were suggested by Carmo et al. [19] to collaborate the requirements of the learners and give them space under one unified umbrella. Index of Learning Styles (ILS) is given by Felder-Silverman model and gives a number of fresh views and suggestions on how to apply the different techniques of learning and integrate them into the various learning patterns. It was observed that learners tend to have troubles in answering long subjective questions requiring them to write long notes as answers. Thus, to accommodate the solution for this problem, small questions of agreement and disagreement to understand the ideology of the learner and determine his/her abilities and loopholes were also assessed. Since varied learners fit in varied environments of learning therefore, a common test should be devised suiting all the varied patterns of learning.
1.7 GENESIS OF THE PROBLEM
The greatest constraint for many organizations is the ability to attract, retain, engage, and develop talent. At the same time, the practical impact of near continuous change and complexity has meant that people in organizations must constantly adapt. To survive in the turbulence that accompanies rapid change; organizations, their workforces, and their leaders must develop the capacity to learn continuously. In this context the only effective development efforts are the ones that increase participants’ ability to act successfully in unique, ambiguous or divergent situations. Yet, many organizations are finding it increasingly difficult to produce the necessary meaningful learning using traditional training methods.

In order to develop a consistent contribution in organizations, a real break from the classroom based educational philosophy of learning through face-to-face interaction must take place, to be replaced by the active, self-regulated nature of meaningful learning. The world is complex, the development of leadership talent is also complex and we are not giving enough treatment in our approach to educational methods while realizing that a given set of requisite skills is continuously evolving. Learning to lead involves dealing with complexity, taking risks, and collaborating with others to bring a myriad of talents to bear on critical issues. The catalyst for development must be the leaders and their ability to benefit from experience. So, what is the role of the organization in orchestrating development? The role may be to enhance diverse opportunities for individuals to garner meaningful learning from experience, on-the-job, in the day-to-day challenges of work and in planned learning activities. In addition, a supporting simulation oriented e-learning approach for the developers can help in smoothening of the real and fast learning curves.

Simulation is targeted for execution on distributed networks, and multiprocessors, as well as sequential architectures. Since 1990s the simulation is expected to provide support for a wide variety of purposes including, training, interaction, visualisation, hardware testing, and decision support in real-time. The power of simulation is that a uniform model execution technique can be used to solve a large variety of systems without resorting to a bag of tricks where one must choose special purpose and sometimes hidden solution methods to avoid simulation. Another important aspect of
the simulation technique is that one builds a simulation model to replicate the actual system.

Simulation is in the midst of what could justifiably be referred to as a revolution. A mere two decades ago, the simulation involved systems analysis using a single model generated by a relatively small group of modellers, analyst, users and/or decision makers. But today, simulation models may adopt countless forms:

1. A single model for system design or optimization which evolves rapidly during experimentation
2. A model which consists of a synthesis of results from several existing models in an effort to answer questions on a meta system level
3. Models used for analysis
4. Models used to animate and visualize systems
5. Models used to provide an interactive training environment
6. Models used to stimulate hardware prior to operational development
7. Models used for real-time decision support
8. Models which provide various combinations of the above

A detailed literature review on simulation has been presented in the next chapter i.e. Chapter 2.

1.7.1 Gaps Identification

After careful review of the literature on learning, e-learning, and simulation, we find that:

1. Not much literature can be found on the use of simulation in e-learning especially in educational institutions.
2. There is no literature available showing how a simulation based e-learning tool can be created and used for supporting e-learning along with traditional learning in the educational institutions of higher education, specifically in India.
3. The authors could not find any account of the impact of such e-learning tools on the learning capabilities of the students in these institutions of higher education, specifically in India.
Hence we thought of exploring this area and to propose some relevant findings on the issue.

1.7.2 Problem Statement

Normally in an Indian context, a general purpose institution of higher learning would have students enrolled in technical courses such as Bachelor of Computer Applications (B.C.A.), Master of Computer Applications (M.C.A.), B.Sc. (I.T.) i.e. Bachelor of Science (Information Technology), and M.Sc. (I.T.) i.e. Master of Science (Information Technology) as well as in non-technical courses like Bachelor of Arts (B.A.), Bachelor of Commerce (B.Com.) and simply Bachelor of Science (B.Sc.) in medical and non-medical streams. As on date, more and more of these students have started supplementing their traditional learning with e-learning, although there are certain social and economical issues that act as barriers to this process. A certain set of both categories of students are not so privileged to supplement their traditional learning with e-learning. As such simulation based e-learning can be an effective technique to enhance the e-learning capabilities of these students in the absence of 24 x 7 web based e-learning.

Hence it is an interesting proposition to evaluate and assess the impact of training on simulation based e-learning tool not only on this disadvantaged group of students but also on the not-so-disadvantaged group. Moreover, a comparative analysis of traditional learning versus e-learning supported traditional learning in the northern part of India can throw some light on the effectiveness of using simulation based e-learning among all the students.

1.7.3 Objectives

This thesis work has been carried out to achieve the following objectives:

1. To create a simulation based e-learning VLE tool i.e. SESeLE so as to train different sets of students (undergraduate as well as postgraduate) on various aspects of using a VLE.
2. To collect responses of different sets of students before and after training on SESeLE through carefully designed set of questionnaires.
3. To assess the effectiveness of SESeLE.
4. To analyse the influencing factors of simulation based e-learning through SESeLE tool across genders among the students of technical courses.

5. To make an assessment of the impact of ICT usages in e-learning among the students of non-technical courses.

6. To compare and analyse the responses of the complete set of students (of technical as well as non technical courses) on various issues related to traditional learning and traditional learning supplemented with e-learning.

1.8 APPROACH FOLLOWED

In order to achieve the above mentioned objectives, the whole thesis work involved the following steps:

1) Literature Review: A comprehensive literature review on the topics of learning, e-learning and simulation was carried out for an in-depth understanding on the general aspects of styles and models of learning, e-learning and simulation.

2) Gap Identification: After assimilating the literature studied, we identified three gaps that required urgent attention.

3) Problem Statement and Objectives: Based upon above two steps, we finalized our problem statement and also the objectives of our thesis work.

4) Identification & Study of MOODLE: In order to train the target students on the concepts of e-learning, we started looking for some freeware or open source tool on the internet that could fit into our scheme of work. So, after a lot of surfing and searching, we found an e-learning tool named MOODLE which was an e-learning tool used solely for the academic purposes in the institutes of higher learning.

5) Creation of SESeLE: After the critical evaluation of MOODLE we found that this tool although very popular, suffered from various limitations especially from the point of view of institution of India. Therefore, we created our own e-learning tool named SESeLE tool that suited Indian academic Institutions of higher learning. To gain confidence of its effectiveness, the tool was first used for fulfilling its various purposes in the academic processes of GGDSD College, Chandigarh. After a number of trials, the tool was brought a stage
where we could have confidence in its use for fulfilling the objectives of this thesis work.

6) Identification of Target Groups as Sample: To train students on SESeLE tool for fulfilling our objectives, we identified two sets of students i.e. a set of students enrolled in technical courses (392 in all) and another set of students enrolled in non-technical course (315 in all) in various institutions/colleges of higher learning in and around Chandigarh city in India.

7) Designing of Questionnaires (6 in all): Q1, Q2, Q3, Q4, Q5 and Q6. The following questionnaires have been designed: Q1) Initial Data, Q2) Pre-training and Post Training Test, Q3) Post-Training Influencing Factors for Group A, Q4) Post-Training Influencing Factors for Group B, Q5) Assessment of the Students of Non-Technical Courses on Awareness of ICT Usage in e-Learning, and Q6) Comparative analysis of Traditional Vs e-Learning among students.

8) Questionnaire Filling up by Students: Next, these students were made to respond to various questionnaire tools (6 in all: Q1, Q2, Q3, Q4, Q5 and Q6). Different sets of students were made to respond to some or all of these questionnaires at different times.

9) Training of Students on SESeLE: After responding to the Questionnaires Q1, Q2 and Q3, the students enrolled in the technical courses were given training on SESeLE about various concepts of e-learning and software engineering. And thereafter, the same set of students was made to respond to the Questionnaires Q5 and Q6.

10) Evaluation of SESeLE: Based on the responses to these questionnaires, a factor analysis was performed on the data so gathered from Questionnaires Q1, Q2 and Q3 to find out the major Influencing Factors in pre-training and post-training of SESeLE.

11) ICT Usage Assessment: The students of non-technical courses of the said colleges/institutions were made to respond to the questionnaires Q1, Q5 and Q6. The questionnaire Q5 pertained to the usage of ICT tools in e-learning by the students of non-technical course. This step was carried out to find out the assessment of these students about their awareness of ICT usage in e-learning.
Literature Review

Gap Identification

Identification & Study of MOODLE

Creation of a VLE i.e. the SESeLE

Identification of Target Groups i.e. the Sample

Design & Filling Up of Questionnaire by Students (Q1 - Q6)

Training of Students on SESeLE tool

Technical Group A & Group B (Q1, Q2, Q3 & Q4)

Evaluation of SESeLE

Gender Analysis on VLE

Non-Technical (Q1, Q5, Q6)

ICT Usage Assessment

Comparative Analysis of Traditional Learning with e-learning

Figure 1.3 Approach Followed
12) Comparative Analysis of Traditional Learning with e-Learning: Based on responses of students of technical as well as non-technical courses to the questionnaire Q6, we carried out a comparative analysis of traditional learning versus e-learning supplementing traditional learning to find out the effectiveness of e-learning for the students of all the courses.

1.9 Contributions of Thesis

One of the major contributions of this Ph.D. thesis lies in the design, application and validation of a Simulation based e-learning through Software Engineering (SESeLE). This SESeLE framework will support the faculty in big organizations in coping with the dynamic complexity of software development as well as that of training by providing guidance in developing and using quantitative simulation models as a source for systematic learning and improvement.

The main achievements resulting from the development of the SESeLE framework can be summarised as follows:

1. Theoretical work:
   Detailed description of a process for SDM development with:
   • Definition of roles, responsibilities, activities, and work products
   • Support in specifying the simulation modeling goal.
   • Provision of guidelines, checklists, templates, and other materials.
   • Integration of System Dynamic (SD) modeling with the GQM modeling method.

2. Practical work:
   • Development of three SDMs for different modeling goals.
   • Integration of one SDM into a web-based training module for students on the topic of Software Project Management.
   • Implementation of the SESeLE process model with VB.Net & MySQL. Based on this implementation, a web-based Process Guide for SESeLE can be automatically generated.
3. Empirical work:

The effectiveness and efficiency of the SESeLE framework is supported with empirical evidence gathered from the working of MOODLE and controlled experiment carried out by us during the thesis work on a set of students.

4. Methodology:

The SESeLE combines state-of-the-art measurement and modelling approaches in the field of software engineering with the System Dynamics simulation modelling method. In particular, the integration of goal-oriented SDM development can be considered an enhancement of the existing GOM method towards "Dynamic GOM". With regard to systematic software process improvement, the SESeLE serves as a vehicle for smoothly extending the yet comprehensive approach – which is based on empirical, experience-based learning – towards simulation-based learning. The effectiveness of this whole set up has then been evaluated through the responses of the target group students using appropriate statistical techniques.

This will help reduce the risk of failure when introducing software engineering technologies or process changes.

1.10 Chapters Layout

Chapter 1 covers the literature survey on general aspects and evolution on learning and online learning styles & models, genesis of the problem, problem statement, the objectives, approach followed, major contributions made by us in the work.

Chapter 2 discusses various aspects of e-Learning system and adaptation in virtual learning environment. We have also discussed about the simulation, types of simulations, designing and developing educational e-simulations, benefits of simulations for experiential learning, barriers to the use of simulations for learning, study the functionality and features of online learning tool MOODLE, introduction to SESeLE, its modules and blocks, functionality and its styles.
**Chapter 3** In this chapter we provide a brief introduction to the system Dynamic Model (SDM) and Goal Definition for SESeLE and its taxonomy.

**Chapter 4** In this chapter we find out the effectiveness of SESeLE based on questionnaires, hypothesis, behaviour, experimental setup and variables, data collection & analysis procedure and anomalies in the data set. We also find out major influencing factors with the help of pre training test and post training test.

**Chapter 5** In this chapter, we carry out the gender analysis of data on virtual learning environment based on responses of students of technical course with the help of hypothesis and graphical representation of the responses of the students of technical courses.

**Chapter 6** We present an assessment of the students of non-technical courses in this chapter on the awareness of ICT usage in e-learning with the help of hypothesis and graphical representation of the responses of the students of technical courses.

**Chapter 7** In chapter 7, we present a comparative analysis of traditional learning versus e-learning supplemented traditional learning, based on the responses of the students of technical students as well as non-technical courses on the issues using offline digital technologies, online communication, online learning facilities and role of e-learning.

**Chapter 8** In this chapter, we summarize the findings of the whole of the thesis work.