2. VIRTUAL LEARNING ENVIRONMENTS (VLE)

2.1 e-Learning Systems

E-learning is known by a lot of names depending upon the purpose for which it is being taken such as: Learning Support System (LSS), Learning Management System (LMS), Managed Learning Environment (MLE), Virtual Learning Environment (VLE), Learning Platform (LP) and Course Management System (CMS) [20]. On one hand where USA uses the term CMS to express e-learning, on the other hand, Europe has it called as VLE i.e. Virtual Learning Environment. The purpose of e-learning is served by a computing system that integrates a lot of software, hardware and networking components in order to provide a simpler but effective user interface to fulfill the requirements of different levels of stakeholders in the easiest possible manner. A number of learning tools such as multimedia, still graphics, video, music, text, moving graphics and many more can also be the integral part of an effective e-learning system.

Along with the provision of a user interface, virtual learning environment also takes care of database handling, files management, feedback management, content management, content delivery, financial transactions management etc. It is not just helpful to the students but also to the teacher/instructors/trainers as well as to the administrator. Two basic forms available for virtual learning environment are: a) commercial mode and b) non-commercial mode which also supports the concepts of open source. Some of the e-learning environments which are extremely popular among e-leaners are WebCT, smart class and Modular Object-Oriented Dynamic Learning Environment (MOODLE).

As such, there is huge difference between the traditional method of classroom learning and e-learning in a virtual environment. Virtual learning at times, takes a toll
on the learner because the onus of learning is squarely on learner himself/herself. Although the learners have anytime anywhere accessibility to the learning material, it is absolutely learner’s own choice to decide on up to what extent the learner wishes to make use of it. Virtual learning environment focuses predominantly more on the solutions to the problems that may occur to a learner at various levels of subjective learning and its focus is lesser on the subject itself. The learning content remains the same for all types of learners unlike the traditional class room teaching where the teacher has the options to accommodate various types of learners.

In the traditional learning the learning is a long process which requires dedication and hard-work from both ends i.e. learner as well as the teacher. A teacher does not only have to play the role of a guide but also of a motivator in case the student needs periodic push and encouragement, not just of an instructor but also a mentor who shows the right direction to the learners at the right time and also warn the learner in case the teacher senses something odd. It is largely the teacher’s responsibility to judge the behavior of the learner and act accordingly.

2.2 ADAPTATION IN VIRTUAL LEARNING ENVIRONMENT

A number of learning models have to be taken into consideration in order to suffice all sorts of learning requirements of the students. The students may have their own ideas of learning and may require their own niche style to learn in the most comfortable manner in order to have the most appropriate output. It is also essential to consider the choice of preferences of the learners. One simple way before devising the suitable teaching methods in an environment of e-learning is to directly ask the learner as to which way he/she might feel comfortable to learn but this is not sufficient considering the domains of their previous learning, competencies and learning manners. The better approach is to finely observe the learner in that environment, study his/her progress report and try to trace his/her learning styles by paying attention to the learners very minutely. As has been explained by Graf in [10], it is in this virtual learning environment that non-commercial methods of learning largely turn adaptive and thus, highly effective.
Three minimum criteria are defined concerning the use of VLEs: an Active Community, a Stable Development Status, and Good Documentation of the system. An Active Community means that the VLE is used widely by many people. It can provide support to a variety of users and have several user oriented systems and activities. To have a stable development status, the integral components of the VLE have to be reliable, error free, not prone to errors and executable in a user friendly operational environment. Good documentation support for the system is very important for its easy installation and customization by its users.

The minimum criterion for the objective of the system is to have the system’s focus on the presentation of content instead of communication functionalities. This should be supplemented with user friendly interfaces and easy- to- use operation. It is essential to ensure that all the equipment/components being used are error-free, reliable and easy to install. From the 36 VLEs studied till 2007, only 9 VLEs meet these criteria: A tutor, Dokeos, dotLRN, ILIAS, LON-CAPA, MOODLE, Open-USS, Sagai and Spaghetti Learning [10]. The features that were supported by these 9 VLE systems are file management, user data, usability, Communication tools, learning objects, management of the user data, usability, adaptation, technical aspects, administration and course management. These 9 VLE’s not only just support adaptability in an efficient manner but also cater to suffice extendibility and personalization. The judgment of the adaptive systems is done by assigning each learner a questionnaire at the initial stage in order to trace the learning pattern of the student and develop the instructions accordingly.

Due to the need of a fast-track method of efficiently detecting the learning pattern of the students/learners, there emerged the Felder-Silverman Learning Style Model (FSLSM) as narrated by Graf in [10]. Before the instructor can infer the learning pattern of the students/learners or besides the student/learner himself/herself explaining it to the teacher, it becomes pertinent to have an electronic system that can detect the patterns by observing the works of the students/learners. This way, it is easier to devise effective measures for the adaptation of the VLE in accordance with the learning pattern of a particular learner.
Therefore, at that point of time, MOODLE seemed to be most trustable with the following critical features:

a) Altering the course handout in accordance with the learning pattern devised for the student
b) Generate courses in a manner that would fulfill the requirements of the student’s learning

With a passage of time it was felt that the MOODLE be extended in order to make it adaptive for transforming it into a true VLE. A learning style detection tool was traced as its first extension. The registration form of MOODLE included the extension as the questionnaire of Felder and Silverman which was based upon Index of Learning Styles (ILS). When the answers given by the students for the questionnaire were kept in careful observation and analyzed, the learning patterns of different students were evaluated and verified and thus, considered to be taken up in the model. The expert model comprised of the authoring tool of the MOODLE. MOODLE provided a number of practice exercises for the learners. The teacher was also expected to present some non-adaptive learning material to students as some students could find learning comfortable with it. The entire study material was stored in the expert model. The third advanced extension was the one that would automatically provide the study material suitng the learner. Thus, separate courses could be taken up in order to fit in with the different styles of different students/learners. The MOODLE has been covered in detail further in section 2.4 of this chapter. The next section provides insight into the use of simulation in e-learning.

2.3 SIMULATION

2.3.1 The Nature of Simulations

With the changing era of technology, the past few decades have witnessed the use of simulations in providing services to researchers, academicians, practitioners, industries etc. A specific use of simulation is to provide training in different fields such as military, economics, medical and science. The era of computing technology has a large influx of tools that have been making the world around us more technical, easier and convenient with the help of contemporary computing aids [21]. The influx
of technology has transformed our lives and made us use it more and more in our day-
to-day life. Simulations definitely have a bearing on such a world and thus, largely
influencing our day-to-day lives. As far as the use of simulation in the field of
teaching is concerned, it is largely used in software engineering, journalism, medical,
public relations, law, business and so on.

2.3.2 What is a Simulation?
A number of definitions have been given by various researchers varying in
accordance with their perception of simulation. As defined by Wikipedia, simulation
can be defined as something of a sort of animitation of a big thing or a process.
Simulation basically offers to represent an abstract behavior or characteristic features
of something. Fishwick has explained in [22] simulation as a process that designed the
computing model of a physical theory or study, analyzing the model on the fore-front
in order to serve the educational purpose of it. Feinstein and Parks in [23] suggest that
simulation is the representation of some giant pillar of examples into a duplicate
model designed to exhibit the purpose of its features. According to them, simulation
has the following properties:

(a) It is based on a model,
(b) It represents some aspect of reality without itself being real,
(c) It involves inputs, manipulations and resultant outputs depending on its
    purpose.

Jones in [24] point out that the above mentioned definitions of simulation do not have
any provision to accommodate human behavior and hence, cannot differentiate
between the real and fake behaviours. He further suggests that as far as interactive
events are concerned, these definitions restricted only to systems, rules, imitations,
payoffs, and representations are neither appropriate nor adequate. Accordance to his
viewpoint, human behavior and approach towards a model is what basically a
simulation revolved around. He supports his argument by suggesting that even
though, it is not mentioned in any rule book that winning is the only element in a
game, yet this element can not be missed out since the game will be meaningless in
the absence of this element. He further seconds his statement by adding that if all the
elements in a game are considered as a simulation, the game will be reduced to nothing more than a simulation itself.

2.3.3. Types of Educational Simulations

One way of categorizing simulations is by their purpose, whether that be prediction, teaching, or entertainment. All of these three purposes can often be seen in a single simulation, particularly in military and economic fields. Another way to categorize them is, by what they simulate, i.e. things, systems and people. These concepts can be presented through a useful 3 X 3 simulation matrix that aligns each of the purposes: prediction, teaching, and entertainment, with what is being simulated: things, systems and people (figure 2.1).

<table>
<thead>
<tr>
<th>Prediction</th>
<th>Teaching</th>
<th>Entertainment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Things</td>
<td></td>
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<tr>
<td>Systems</td>
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<tr>
<td>People</td>
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</table>

Figure 2.1: 3X3 Simulation Matrix

Klabbers in [25] suggests that the simulations in the past have been categorized on the basis of events, processes and activities. However, he perceives problems with this categorization since it deals only with discrete events, and does not include continuous models and leads to a linguistic division rather than the one based on model design. He contends that categorizations should provide a unified framework that does not rely on terms such as discrete or continuous.

Hence he proposes three simulation models based on closeness and openness of models. In closed models, the interaction with the system occurs: (a) through an expert and there is no actor to address (zero actor option) and (b) in the one or n actor option. through an expert and facilitator. In open models available currently, the interaction can occur through an expert, a single user, or a number of users.
thereby, interaction occurs via zero actor, one actor, and $n$ actors. The key point is that users cannot change the structure, so the potential for experimenting is bounded by the structure of existing rules and resources. Having considered the literature on notions of (a) learning as acquisition which he equates with artificial systems structured by the external information the learners receive and (b) learning as interaction, which he equates with structured environments by its system of interactions, Klabbers then goes on to suggest that there exists a third simulation model, the participative interactive model, where learners are given the opportunity to interactively build their own system of resources and rules.

Lean et al. in [26] have identified two main types of simulation for educational use. The first is of tactical decision type and focuses on gathering and interpreting data, then developing specific strategies to achieve particular goals. The second is of social-process type and focuses on the study and analysis of human interactions and communication aimed at achieving social or political goals.

In a brief review of the literature, Shedroff in [27] puts forward three types of simulation-based learning which have already been identified in different previous studies:

- **Role Play** - where learners adopt a particular character role. They may interact with other role players, though it can also be non-interactive.
- **Gaming** – which involves interaction within a programmed context generally including elements of competition, cooperation, conflict or collusion.
- **Computer Simulation** – which aims to replicate system characteristics using Mathematics or simple object representations.

Essentially though, he also proposes that simulations for learning aim to imitate a system, entity, phenomenon or process and try to represent or predict aspects of the behaviour of the problem or issue being studied.

### 2.3.4 Design of Educational e-Simulations

Over the past few decades, theoretical positions relating to simulation design have gradually emerged from different disciplinary traditions. For example, Herskovitz in
[28] presents a design theory to meet the need of organising and presenting data in new and different ways. He offered a unified field theory called Information Interaction Design, which involves the intersection of three disciplines, information design, interaction design, and sensorial design. The roots of information design are in publishing and graphic design; interaction design comes about essentially through story-creating and telling and; sensorial design uses all techniques with which we communicate to others through our senses. He further suggests that focusing on one of these areas without the others would result in unbalanced experiences for users.

The field of validation of computer simulation has been the subject of theoretical research for a number of years. During the 1990’s, attempts have been made [29][30] to provide theoretical frameworks to underpin computer simulation by drawing on scientific philosophies that ranged from objectivism to relativism. Stewart and Brown in [31] argue that the validation problem in simulation is an explicit recognition that simulation models are like miniature scientific theories therefore these can be discussed in scientific terms. The authors in their work describe various philosophical positions, summarized problems and evidentiary arguments associated with each. They have also presented a variety of approaches for simulation validation that reduce the methodological burden by converting the process into an ethical problem rather than one requiring scientific validation.

Fishwick in [22] argues that the sophistication of computer-based simulations is not matched by sufficient theoretical underpinnings, which are rudimentary and underdeveloped. Based on earlier work by Herskovitz in [28], he presents a detailed argument for using Popper’s falsification theory as a philosophical foundation of computer simulation validation. He discusses key elements of the theory to suggest that all scientific theories must be constructed in such a way that they are falsifiable or refutable, thereby putting themselves at risk. He further states that according to Popper, scientific progress comes through trial and error, conjectures and refutations; falsified theories must be rejected conclusively because a counter instance is fatal to a theory.

Theories should be subjected to severe tests. Even if they pass, they can still only be regarded as conjectures. Theories are not conclusively proven as true (via induction); they are merely regarded as not falsified. He then applies this notion to simulation
design and argues that developers of simulation models are in fact Popperian falsificationists; because they proceed by a method of conjectures and refutations. If the output data from the simulation is consistent with expected data from the real world, the model is regarded as valid. The actual truth of the model cannot be logically ascertained through observations of the world.

A model that conforms to the real system is regarded as validated and the one that does not conform is regarded as falsified. The question for simulation designers and developers is whether the validated model is sufficiently accurate for the purpose at hand. To the extent that nothing can ever be regarded as true, only valid and aligned with experience, Popper’s theory is consistent with aspects of the constructivist view discussed in [29][30][31].

Other theorists developed positions about simulation design by applying the characteristics of System Dynamics (SD). However, Gredler, who focused on learning in interactive environments, has questioned aspects of this approach in [32] by asking as to who are the judges or owners of such a purpose; who can put themselves best in the role of model builder, who can judge the validity of structure, and who are the owners of a particular structure. He argues that the theoretical basis was lacking unless these questions were addressed from the perspective of social systems theory. Gredler distinguishes between first order and second order social systems theory. First order theory is the application of classical systems science, which is from the traditional positivist tradition. Second order theory is based on ideas relating to fields such as voluntarism, auto poises, and constructivism, where concepts such as organization and structure play an important role. He then presents two generic SD models that represent two different heuristic learning environments called Traditional Simulation (Non-trivial machines) and Multiactor Simulation. The former, based on closed SD models, are characterised as synthetically deterministic, history dependent, analytically indeterminable, and analytically unpredictable. Whereas in the latter, actors communicate, share or withhold values, knowledge and information to gain influence. Drawing on rules, they enact a system of interactions, develop strategies for steering resources, and have distributed access to the model. The possibility exists to intervene in the behaviour of the subsystem which leads to the development of the social system over time.
2.3.5 Designing and Developing Educational e-Simulations

As reflected in the theoretical discussion, the design and development of e-simulations for enhancing learning is a complex subject. However, the author in [32] has provided useful guidelines to assist the process. Accordingly the design of successful educational simulations is based essentially on the following:

- Authentic and relevant scenarios
- Applied pressure situations that tap users' emotions and force them to act
- A sense of unrestricted options
- Replay ability

A vision for the future of learning where simulations are a common place and conversation are paramount, should include the following simulation design principles:

- Sub-system characteristics relating to inputs, calculations, and outputs, need to be identified and defined with some common goal in mind. These should reflect enriched learning, and three content types (linear, cyclical and open-ended); and be easy to customize.
- While simulation designers may be drawn to multi-player educational simulations because they are entertaining and/or competitive, there are educational reasons for not doing so because these will inherit all the problems of role-playing.
- For using simulations as valid teaching tools, designers have to make decisions about the degree to which simulations have to be predictive and/or of very high fidelity.

Many e-simulations use interactive scenarios or role-plays to enable learners to experience and respond to real world problems and events. A range of responses may be necessary and may involve observations, decision-making, interpreting data and solving problems.
Wenzler in [33] notes that while there is software available to help with authoring learning objects; one of the hardest tasks is the planning and storyboarding of the scenario itself. He presents a useful 3-step approach summarised below:

- **Step 1—Initial Decisions:** These are based on planning questions associated with learning objectives and educational design: expected learning outcomes, where the interactive scenario fits in the course structure; assistance; reflection and feedback for learners; delivery options, individual or team-based, and so on.

- **Step 2—Determining the Essentials:** This covers aspects relating to development of a script, the essential objects that need to be included, and the use of a whiteboard to map ideas.

- **Step 3—Developing Schema:** Simple table-based schema are recommended for the content before incorporating these in the chosen authoring tool. Templates can be used to facilitate this. The advantages of schema are that these exist as an easy-access repository of the initial content and both the structure and content of a scenario can be used for alternate forms of delivery.

Despite the various technical tools available for creating scenarios, Wenzler proposes simple techniques like using a whiteboard and developing a table-based schema to provide a sound framework for development of scenarios.

A more comprehensive approach to design is suggested by Herskovitz in [28], where he recommends a unified field theory that brings together information, interaction, and sensorial designs as mentioned previously. He argues that the process of creating is roughly the same in any medium and that almost all interactions can be created by one process. This process involves a continuum of understanding that involves:

- **Data**—involves research, creation, gathering and discovery
- **Information**—involves organization and presentation
- **Knowledge**—involves conversation, storytelling and integration
- **Wisdom**—involves contemplation, evaluation, interpretation and retrospection.

He represents this continuum graphically with overlapping circles and maintains that data on its own does not give a complete message; it has to be organized and
presented in a meaningful way to provide information. Information is used as a basis for interactions and communication with others to bring about knowledge through a process of integration. Wisdom is described as a kind of meta-knowledge of processes and relationships gained through experiences. In discussing interaction design, he refers to continua of interactivity ranging from passive to interactive; involving various levels of control and feedback, productivity and creative experiences, adaptive experiences, and communicative experiences. Sensorial design, as described by him, incorporates those aspects of creation and media presentation that involve the senses, tactile, visual and auditory. Sensorial media present the experiences to learners in appropriate and meaningful ways. Each of these aspects of design must be addressed to ensure a balanced complete outcome. In considering whether simulation interventions deliver the expected value, Collins in [34] has identified and discussed the following ten commandments for translation of results into real life performance:

1. Get a clear understanding of the need.
2. Get a clear understanding of the value to be delivered.
3. Get a clear understanding of the risks involved.
4. Get a clear understanding of stakeholder agendas and capacity for sponsorship.
5. Ensure that the objectives are clear, specific, and measurable.
6. Ensure that the design process is iterative and interactive.
7. Ensure the operational excellence of the implementation process.
8. Determine the simulation effects on learning.
9. Communicate the relevance of what has been learned.
10. Ensure that learning is translated into action.

He has provided examples to illustrate each commandment, and argues that these are an integral part of the simulation design process. Indeed, these represent a common sense approach to design that reflects what is known to be good education design practice.

2.3.6 Issues in Simulation Design

Jones in [35] discusses some general design issues pertaining to constructivist learning environments. The first problem deals with authenticity, which raises
questions about the potential uses of the knowledge, and ways in which learning environments can be created to reflect those uses. The second is about what to teach. About this, he discusses the dichotomies between: memorization and thoughtfulness; whole tasks and component skills; breadth and depth of knowledge; diverse and uniform expertise; access and understanding; and cognitive and physical fidelity. The third problem includes deliberations about how to teach or how to create appropriate learning contexts. Decisions need to be made as to whether the learning is highly interactive or not, incidental or direct, fun or serious, natural or efficient, and whether the learner is in control or not.

Decisions about all these issues revolve around the costs/benefits of designing particular environments. Jones further suggests the need for a rethink about all of these issues so that learners are prepared for life in the 21st century. He argues for a cognitive apprenticeship approach where learning is to be considered in particular work contexts. The apprenticeship model incorporates methods such as modeling, scaffolding, coaching, articulation, and reflection. It is a useful model for designing e-simulations.

Another important issue about the simulation design is an answer to the question: Do you know what you know? This issue in fact, relates to assessment. It is more difficult to assess simulation material than text-book material. Kolb et al. in [36] raise another critical issue pertaining to fear of emotions that is not frequently discussed. They suggest that it inhibits the effective design, briefing, running, and debriefing of interactive learning events. For example, teachers are usually regarded as the subject-matter experts in control and so are reluctant to deliver in favour of more exploratory learning events. Similarly, users of simulations may experience emotions that they and their teachers may find troubling. These are often left unexplored.

Yet, Kolb in [37] argues that emotions have surprising variety, richness and subtlety. They are more rational than often thought, and should be brought out during debriefing because they offer opportunities for deeper learning and understanding. In higher education institutions, some other issues have become apparent in the last couple of years. For example, there is debate about whether to build simulations in house, or buy existing ones.
2.3.7 Benefits of Simulations for Experiential Learning

There is an abundance of literature on the experiential learning approach, incorporating scenario-based learning, case studies and role-play, all of which are commonly used in simulations [37][38][39][40][41]. This approach consists of a four-stage cycle: concrete experience, observation and reflection, abstract conceptualisation and active experimentation. Kolb et al. in [39] regard experience as the source of learning and emphasise the importance of assimilation of concrete experiences followed by observation and reflection on them in order to develop abstract concepts. D. Tonks is also a well-known proponent of experiential learning. In [42], he emphasizes on a student-centered approach to learning and also suggests that the experience of teaching is a dynamic process of renewal. For him, the relation between teacher and learner is crucial because the experiential learning of the teacher determines the kind of experiential learning he gives to learners.

The experiential learning is often associated with the notion that learners should educate themselves rather than be educated conventionally and it is often a feature of learning through simulation [43]. In a more recent paper, Lave and Wenger in [44] reinforce the nature of experiential learning theory and introduce the concept of learning space. It builds on the notion of life space, which embraces needs, goals, unconscious influences, memories, beliefs, events of a political, economic, and social nature, and anything else that might have direct effect on behaviour. The concept also draws on work relating to the ecology of human development which enables analysis of the social system factors influencing learner’s experience of their own learning spaces and on situated learning theory proposed [45]. This theory considers learning as a transaction between the person and the social environment. It may not necessarily refer to the physical spaces, but constructs the person’s experience in the social environment. The concept of learning space extends beyond the classroom to include wider communities of practice that involve membership, identity formation, moving from novice to expert and incorporating experience in the activities of the practice [44].

Reeves et al. in [46] show that scenario-based e-learning is akin to experiential learning: both are carried out in real contexts. In scenario-based learning, they suggest that the learning is a natural by-product of authentic activities commonly used in the community of practice in which the learner is involved. The meaning of knowledge is
contextual i.e. concepts that are away from their context cannot be understood properly. In making a case for scenario-based e-learning, they compare it with traditional learning approaches, and suggest that learning occurs when we immerse ourselves in a situation in which we are forced to perform. The experience involves following success and failure paths through a realistic situation, something which is usually built into simulations.

Experiential learning incorporates authentic activities that have some particular characteristics in common. The authentic activities as proposed in [47] and [48] are:

- To have real world relevance,
- Learners are required to define the tasks and sub-tasks needed to complete the activity,
- Complex tasks to be investigated by learners over a sustained period of time,
- To create polished products valuable in their own right rather than as preparation for something else,
- To provide the opportunity for learners to examine the task from different perspectives, using a variety of resources,
- To provide the opportunity to collaborate,
- To provide the opportunity to reflect,
- Seamlessly integrated with assessment and
- To allow competing solutions and diversity of outcome.

These characteristics indicate that the nature of authentic activities is consistent with notions of experiential learning and learning space as described by Lave and Wenger in [44] as well as scenario-based learning described by Reeves et al. in [46].

The simulations can further enhance educational goals because they are a powerful tool for learning. Learners using simulation for learning generally have higher motivation level; they are able to acquire more usable transferable knowledge; and this active learning approach is more likely to lead them to deeper learning. Therefore, the possibility of achievement of learning goals through simulations is higher. The environments created, enable the learners to apply theoretical and practical skills to real world issues in their respective fields and allow teachers to integrate a number of
objectives in the simulation process. So it can be also argued that simulations can help bridge gaps among disciplines and between academics and practicing professionals. As far as the assessment of the effectiveness of experiential learning is concerned, common conceptual concerns do not exist within the groups of researchers whose scholarly focus is experiential learning, and at times the validity of simulation are questionable. Cherryholmes in [49] has identified the following four ways of addressing the shortcomings in the field of using simulations in e-learning:

- Attend to research design by incorporating pre-tests and post-tests, treatment and control groups, and random assignment to groups.
- Define outcome variables and ensure that they are objective, and appropriate for the experience being assessed.
- Tie learning measures to explicit learning goals.
- Ensure that measures are valid.

Although use of simulations is broad, attempts to evaluate their effectiveness have been narrow. It appears that over a period of time, the extent of usage of simulations exceeded the level of research focusing on it.

2.3.8 Use of Role Play in Simulations

It appears that Piepy D. is the one who published earliest research work on the learning benefits of role-play simulations [50]. For this purpose he has conducted six studies on the use of complex simulations focusing on learners’ interest levels and attitudes, critical thinking, learning and retention. He finds that the only difference between using simulations and other methods such as case study and classroom techniques is that interest levels are higher in simulations. In terms of learning, very little difference has been found. Similar findings have been reported in other studies. Dekkers and Donath in [51] have reviewed comparative evaluation findings from the 1960s and 1970s and conclude that 15 of 21 studies have found no difference between simulation use and other teaching approaches as far as learning is concerned. Regarding retention, in 8 out of 11 studies, learners using simulations have retained knowledge for a longer period than others using traditional methods. In 7 out of 8 studies, interest levels have been found to be higher when simulations are used.

Josephine in [52] conducts a meta-analysis of 93 research studies on simulation use for cognitive development or retention purposes. They suggest that simulations are
only better than traditional lecture methods for attitude formation. They also conclude that although simulations are effective for learning, they are no better than other approaches; however, they are better for aiding retention and creating positive attitudes. Catanese et al. in [53] support this by observing that the use of simulations is more advantageous in terms of motivation, commitment and involvement.

Druckman and Ebner conduct a larger review of 69 studies as reported in [54]. In 60% of them, no difference is found between simulations and other methods. However, some differences are reported in 40% of the studies, most of which relate to language, arts and mathematics. As in the case of previous studies, these authors find that generally in social science subjects, use of simulations does not appear to improve learning but does aid retention and enhance interest in subject matter.

According to Francis and Byrne several researchers made suggestions on how to improve the value of simulations to learning [55]. These suggestions include: (a) clarifying learning objectives, (b) preparing learners by providing more conceptual background on the subject prior to the simulation activity, (c) building for reflection on the events and getting feedback and (d) providing concept maps and graphics to indicate the purpose of the simulation. These aspects need to be emphasised in the process of simulation design.

Their study appears to indicate an improvement in value. Whether it is a result of more attention to the design process or not is difficult to determine. In order to find out the relative learning benefits of simulation, role-play and design. the authors consider 85 participants who are located in two different institutions, and are assigned to either a role-play scenario or a design situation. All of them attend the preceding lecture, although there is also a control group who only attends lectures. Following the lecture, the designer group is given detailed instructions on designing a scenario that has to be easily understood by the role players. After the design phase, the task of the role players is to learn from the simulation about concepts that have been presented in the lecture. All participants then complete a questionnaire about their experience. Findings from this experiment are summarised as follows:

- The process involved in designing scenarios enhances short term concept learning more than playing roles in those scenarios. Control group participants learn less about concepts than designers.
• Designers understand the relation between concepts better than the role players. Indeed role-playing participants did not learn concepts more effectively than those in the control group who only attend lectures.

• Both roles retain what they learn immediately after the exercise. Role players do not improve their initial understandings, whereas designers are better able to answer retention questions.

• Designers not only learn more, they are also more motivated than role-players and control group.

The authors of this paper then conclude that designers get more out of their experience than role-players and lecture only for learners. While acknowledging the study limitation of generalisability (for example the expertise of designers in rating suitable role play scenarios), the implications of the study are that it supports the case for complementary and sequential uses of role-play and design. Replications of this research are required in order to further test the results.

2.3.9 Barriers to the Use of Simulations in Learning

As with many innovations in institutional settings, there are significant barriers to the use of simulation-based learning, at least as far as perceptions are concerned. Evidence for this can be found in a number of studies related to the use of simulated role-play or games. For example, time demands and high workloads are suggested as the key barriers and another barrier found is the anxiety felt by academics when putting experiential approaches to trial [56][57][58]. Savoldelli et al. in [59] suggest that inadequate preparation time is cited by academicians as being the main barrier to adoption of simulations in their teaching. Other barriers discussed by these authors include (a) the perception that simulations do not fit into their courses, (b) information about simulations is inadequate, c) other teaching approaches are preferred, (d) funding is inadequate, and (e) difficult technical and administrative issues arise.

In a quantitative study, Dougiamas and Taylor in [60] document a survey of 154 anesthesiologists on their experiences with, and perceptions of, simulation-based learning. In addition to commonly cited barriers relating to inadequate time, financial resources and fear of peer judgments, they find that the level of training of anesthesiologists influences attitudes and perceptions towards the use of simulations for learning. Resident anesthesiologists have been found to have more experience with simulations, attended more simulation classes, and found it more relevant for
their training than the staff who conducted the training. The latter have been found less interested in using simulations.

Shedroff surveys staff perceptions of barriers and presents his results in [27]. Questions asked form the staff are based on a typology of simulations and on whether respondents are current, former or never users. He confirms that limitations with regard to teaching development time, resource allocation, and administrative/technical support, all prove to be the strongest barriers. The most frequently used techniques have been formed to be role-play and non-computerised games indicating a broader pattern of usage than expected. These techniques are related to humanities and social science subjects, in addition to the science-related subjects, which usually used simulations. Factor analyses of the data collected by the author highlights three areas: suitability, resources and risk of the unknown. The results indicate that in respect of resources, there were no significant differences between users and non-users suggesting that resource limitations do not prevent adoption if staff is interested and motivated enough. However, he proposes that risk levels are likely to be associated with adoption.

He further states that there was insufficient information on the use of simulations that was required to provide staff with the level of confidence needed for adoption. The outcomes of using such approaches might be less predictable than in the cases with other teaching techniques. The author concludes that, since most of the staff members who have not used simulations have agreed not to discount any future use, adoption is more likely to be based on suitability and risk rather than on resource levels.

2.4 MOODLE

Martin Dougiamas was the one who founded MOODLE which is an open virtual learning environment [60]. MOODLE stands for Modular Object-Oriented Dynamic Learning Environment. It has the following features:

- Basic material for teaching
- Formal procedures for assessments.
- Instructors and learners have separate platforms for accessing the community on web.
- Conduct of quizzes which can calculate the score result simultaneously for self-assessment.
Communities have discussion forums, news rooms and internal mailing
- It can support a number of courses.
- Facilities of registering students and tracking them
- Tools of administration
- Tools provided for insertion of various hyperlinks and help in creation of a number of documents of learning.
- Chats within the groups along with the moderator.
- Extra learning material and links to a number of resources on wed and references made of various books.

The basic objective behind the establishment of MOODLE is to facilitate the educators to develop online courses to have a wider reach to the learners all over the world. The first ever version of MOODLE that came into being in the markets was in 2002. Ever since that, it has been re-modified and evolved multiply over the time.

2.4.1 Modules and Features

There are three divisions in the MOODLE page. The section of course is handled and updated by the teachers. MOODLE consists of numerous modules and links for an efficient and nourishing experience of e-learning. The modules help in communication and provide good quality learning material:

<table>
<thead>
<tr>
<th>Activity Module</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>FORUM</td>
<td>This helps in holding discussions to suggest views for <em>betterment, and discuss matter of study and learning.</em> This may also include attachments.</td>
</tr>
<tr>
<td>QUIZ</td>
<td>Presents questions to the learners on the basis of which they can evaluate themselves and it shows the scores simultaneously.</td>
</tr>
<tr>
<td>QUESTIONNAIRE</td>
<td>Helps the teacher in the conduction of surveys with the use of questionnaires.</td>
</tr>
<tr>
<td>LESSON</td>
<td>Learners are provided with choices to choose the sequence of their lessons which comprise a number of pages. Each page leads to the other page lying in the sequence.</td>
</tr>
</tbody>
</table>
TABLE 2.1: Activity Modules in MOODLE

There is a provision in MOODLE where students can submit their files and documents to be evaluated by the teacher. This module is meant for the submission of assignments. Forum module is meant for providing a common shared platform for discussion on various course related topics among the learners. Resource module is meant for teachers to upload and update study material and various hyperlinks for efficient learning. Wiki module is helpful for learners using wiki pages to be used in their presentations and work material. The given table above describes about the various modules included in MOODLE.

<table>
<thead>
<tr>
<th>Feature</th>
<th>Provision</th>
</tr>
</thead>
<tbody>
<tr>
<td>Activities</td>
<td>The activities that are used in the course</td>
</tr>
<tr>
<td>Administration</td>
<td>Administrative tools for editing the page and users</td>
</tr>
<tr>
<td>Feature</td>
<td>Description</td>
</tr>
<tr>
<td>-------------------------------</td>
<td>-----------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Calendar</td>
<td>A mini-calendar which shows event days in different colors</td>
</tr>
<tr>
<td>Course/Site Description</td>
<td>An HTML block where a faculty member can write a description of the course</td>
</tr>
<tr>
<td>File Manager</td>
<td>A Folder where learners can save their files</td>
</tr>
<tr>
<td>HTML</td>
<td>A HTML block where learners can write text in HTML</td>
</tr>
<tr>
<td>Latest News</td>
<td>Latest news related to courses updated to News Forum</td>
</tr>
<tr>
<td>Messages</td>
<td>Exchange of messages through MOODLE Message System</td>
</tr>
<tr>
<td>My Course</td>
<td>User's course</td>
</tr>
<tr>
<td>Online Users</td>
<td>Users who are online for the past 5 minutes</td>
</tr>
<tr>
<td>People</td>
<td>Participants of the course (learners and teachers)</td>
</tr>
<tr>
<td>Quiz Results</td>
<td>Results of a Quiz made available on My Course</td>
</tr>
<tr>
<td>Recent Activity</td>
<td>Recent user activity in the My Course (Club, Forum Posts etc.)</td>
</tr>
<tr>
<td>Search Forums</td>
<td>A Search engine for the forums</td>
</tr>
<tr>
<td>Time</td>
<td>Keeps record of user's login time for My Course</td>
</tr>
</tbody>
</table>

**Table 2.2: Important Feature in MOODLE**

The table given above shows the salient features of MOODLE. The feature named as 'administration' is meant only for the teacher and is visible to the teacher itself. This feature enables the teacher to update and upload the study material and any important notice or information regarding the course for the learners. A common pool of file available for both learners as well as teachers is with the help of the feature 'file manager'. Here, students as well teachers can add files. It allows to make choice for who shall the files added be available and visible. There is a feature called 'my courses' in which learners can see and check which all courses have they taken and which are yet to be taken. Some features are meant for surveying while others may be used for multiple purposes. The tools facilitated by MOODLE are: feedback, quiz, survey, questionnaire, form modules and choice. 'Choice' module enables decision.
making. Surveys on studying are conducted by three sub-categories of ‘survey’ module namely: COLLES which stands for Constructivist On-line Learning Environment Survey; Critical Incident Survey; ATTLS stands for Attitudes to Thinking and Learning Survey. ‘Quiz’ module helps in the self-assessment and simultaneous evaluation of scores and development of examination papers and thus, conduction of survey. Pictures can also be a part of these quizzes. Quizzes can be of any form such as: matching, questions requiring descriptive answering, true/false, multiple choice questions. short answer, embedded answers, numerical and so on. ‘Questionnaire’ module has an available question bank in which questions of various courses can be added as well deleted. ‘Feedback’ module enables the learners to give their suggestions and suggest changes along with their requirements. Choices for questions can be: text field, dropdown menu, radio button, label picture, check and text area. ‘Form’ module can also help in generating questions. All the tools can be accessed by using Excel Worksheet.

2.4.2 Using MOODLE and its Functionality
MOODLE helps in multiple ways and not just in studies and learning. a number of communities meant for various purposes are created by the help of MOODLE. MOODLE is efficiently used to serve a number of fields such as information, communication, delivery of material and so on. MOODLE is prevailed in a number of groups, communities, companies. schools, colleges and many more. Its diverse nature makes it available for a number of stances and platforms such as group sites containing chats and discussion forums for various purposes. MOODLE is available as a freeware on the web as http://www.moodle.org. it was initially developed for AOL University of Germany for the purpose of Quality Management System. It enables users to visit the site and make editions. But the number of people accessing these facilities is kept limited. There is a key called tracking facility with the help of which users can make the administrative activities transparent.

2.4.3 Limitations of MOODLE
It is contradictory to find limitation in such a highly classified set of salient features which are available for a great amount of use on the web. The limitations cited are as
follow:

a. The MOODLE e-learning system is not efficient enough to support the Indian Education System.

b. MOODLE e-learning system does not support complex models of many types of business as it was never designed to do so.

c. The feature of self-assessment for learners is not supported by MOODLE e-learning system.

d. The traditional system of learning in the classroom is not supported by MOODLE e-learning system.

e. The tough system of MOODLE e-learning scoring and grade system does not fit Indian Academic System.

f. MOODLE e-learning does not have the ability to align with Human Resource Management System.

g. MOODLE e-learning system cannot be aligned with the administration system of a number of colleges and departments since it does not support distributed administration model.

h. There is no synchronization between the student information compiled by MOODLE and administrational activities.

2.4.4. SESeLE

MOODLE is used to create an atmosphere of virtual classes through online learning and is not feasible to be used for traditional system of classroom learning. SESeLE (Software Engineering Simulation Based e-Learning Environment) was developed to overcome the limitations of e-learning and support the traditional learning environment.

It is developed with the help of VB.Net and My SQL to integrate it with software called Campus Analyzer developed to support a certain college in India. This software does not only support MOODLE: but also helps in over-shadowing the back drops of MOODLE. GGDSD College, Chandigarh, affiliated to Panjab University.
Chandigarh, India uses this software as a tool to support many experimental activities. This software supports a number of activities in the college and act as a catalyst in the running smoothly many works such as accounting, staff payroll, admission module, management, hostel module and library module. A number of users playing various roles can use the software to enhance the efficiency of working in their respective jobs such as Principal, Faculty, Staff, Students, Parents/Authorized Guardian. The SESeLE provides all the salient features of MOODLE along with providing the atmosphere of traditional system of learning having assignments, online courses, assessments and declaration of results.

Some of the advantages of integrated Campus Analyzer and SESeLE software are displayed as follows:

i) Although, it is all about e-learning but it also facilitates traditional system of classroom learning.

ii) Shared information has a transparent flow.

iii) Security of data is ensured.

iv) Reports are displayed according to customized search.

v) Includes numerous MIS reports for the Dean and HOD’s of college.

vi) Additional reports are generated by export facility.

vii) Can be used by anyone such as teacher, student and administration.

viii) It is user friendly and avails internet.

ix) All the functional areas are integrated.

x) The flexibility of databases and a huge support.

SESeLE integrates the works of student, teacher and administration along with the features of Campus Analyzer software. The software is categorized into four major modules which are described briefly below:

**Administration:** this particular module was devised for the efficient usage of the administration which includes the following features: academic calendars and schedules are uploaded under this. syllabus and links along with resource material is uploaded here. teaching schedules of each faculty is placed here. question banks are also available under this particular module.
Table 2.3: Blocks in SESeLE

**Faculty**: this is in provision of useful methods of efficient working for the faculty wherein they can upload the course material for various courses taken by the students. They, under this module, also upload the plan of the entire course for all the faculty members, question papers and also take care of assignment submission and evaluation and facilitate the enquiries of the students related to their course material.

**Student**: all the uploaded study material is available in this module. There is an availability of a forum where students can discuss the topic and related doubts with the teacher even if the teacher is online or not. A proper deadline of time is given in which students need to submit their assignments under the assignment module. Online tests are conducted according to the sequence of the topics appearing in the course and each topic consists of three levels each of which a student needs to clear before starting the next topic. A student needs to clear the test with a minimum weightage of 70% in the absence of which a student requires to re appear for the test again and again.

**Reports**: all the reports regarding students, teachers, faculty members, administration are displayed here along with the results of examination, online test, assignments and interaction level which are exhibited with the help of graphs and simulations.

<table>
<thead>
<tr>
<th>Modules</th>
<th>Administration</th>
<th>Faculty</th>
<th>Student</th>
<th>Reports</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sub-modules</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Question Bank</td>
<td>Notes Bank</td>
<td>Study Content</td>
<td>Examinations</td>
<td></td>
</tr>
<tr>
<td>Syllabus</td>
<td>Online Question Master</td>
<td>Interaction</td>
<td>Online Assignments</td>
<td></td>
</tr>
<tr>
<td>Sections/Units</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Academic</td>
<td>Study Plan</td>
<td>Assignment</td>
<td>Online interactions</td>
<td></td>
</tr>
<tr>
<td>Calendar</td>
<td>Master</td>
<td>Submission</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Course Details</td>
<td>Assignment</td>
<td>Online Test</td>
<td>Feedback on e-</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Master</td>
<td></td>
<td>learning statistics</td>
<td></td>
</tr>
<tr>
<td>Unit Master</td>
<td>Study Plan</td>
<td></td>
<td></td>
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</tr>
<tr>
<td></td>
<td>Update</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Syllabus Details</td>
<td>Study</td>
<td>Assignment</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Assignment</td>
<td></td>
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</tr>
<tr>
<td></td>
<td>Student</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Enquiry</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
2.4.3 SESeLE and Learning Styles

The emergence of SESeLE gave rise to a number of learning approaches. As studied closely, there are two major distinctions made in the learning styles which are: connected knowing and separate knowing. Connected knowers learn in unison with other learners and feed upon the ideas of other learners whereas separate knowers are critical to learning and have an debating approach. SESeLE provides a healthy environment conducive to learning and encourages a connected knower approach with the exploitation of their complete potential. A number of hypermedia systems are enabled by SESeLE such as MANIC which stands for Multimedia Asynchronous Networked Individualized Courseware and IDEAL which stands for Intelligent Distributed Environment for Active Learning which facilitates adaptation of various learning approaches but does not integrate the usage among administration and faculty simultaneously. On the other hand, Virtual Learning Environments (VLEs) provides excellent efficiency for the administration [61]. But it is not adaptive to multiple learning approaches. This issue was raised by the authors of SESeLE which have tried to provide solutions for the same along with a nourishing e-learning environment.

2.5 CONCLUSION

To create an adaptive learning environment, sufficient learning models that consider learners backgrounds and learning preferences are required to be created and actively dealt with. The majority of these adaptive systems have used the traditional collaborative student modeling approach of questionnaire to detect their learning styles. Graf introduces Felder-Silverman Learning Style Model (FSLSM) to automatically detect learning styles in VLE. Other theorists developed positions about simulation design by applying the characteristics of System Dynamics (SD).

There is abundance of literature on the experiential learning approach, incorporating scenario-based learning, case studies, role-play and authentic activities all of which have characteristics commonly used in simulations. The notion that learners should educate themselves rather than be educated conventionally is key feature of learning through simulation. The simulation is a powerful tool for learning that can further enhance educational goals and high motivation levels. This active learning approach
is more likely to lead them to deeper learning experiences and to acquire more usable transferable knowledge.

Tying learning measures to explicit learning goals is an important key factor here. After the design phase, the task of the role players is to learn concepts from the simulation presented in the lecture. The understanding of the concepts is much more when playing roles in those scenarios meaning thereby, the control group participants learn less about concepts than designers.

In order to support simulated learning and to overcome MOODLE’s other limitations highlighted earlier in the chapter, the authors have developed a software tool called SESeLE (Software Engineering Simulation Based e-Learning Environment) tool. While creating SESeLE software, online pedagogy and some learning styles have been learnt closely. This tool provides an online e-learning platform for simulated class room teaching/learning environment and includes online courses, assignments, evaluations and result displays. SESeLE encourages learners to become connected knowers and facilitates a productive environment conducive to learning with full potential.