CHAPTER II

REVIEW OF RELATED LITERATURE

- Theoretical Overview.
- Software Review.
- Review of Related Studies.
- Conclusion.
Review of related literature is one of the most important steps in any research study. Review helps the researcher to familiarise with what is already known untested in the field of the study. This step helps to eliminate the duplication of what has been done, to provide useful hypotheses and helpful suggestions for significant investigation, to know about the methodology and the tools that are needed for the study and the significance of the present study.

The main purpose of the study was the development of a Moodle based Learning Management System (M-LMS) and its validation. For this, the investigator made a thorough review of related resources. It is described below under four heads.

• Theoretical overview.
  • Framework review of the Web based LMS
  • Component review of the Web based LMS
  • Theoretical basis of the web based LMS

• Software review.
  • Moodle
  • KStars
  • PhET
  • PHP
  • MySQL
Review of Related Literature

- Adobe Flash
- Python
- Adobe Dreamweaver
- Social networks

- Review of related studies.
  - Studies on the use of computers in education
  - Studies related to Interactive and Online Learning Environments.

- Conclusion

**Theoretical Overview**

Instructional development provides a process and framework for systematically planning, developing and adapting instruction based on identifiable learner needs and content requirements. Procedure for the production of computer based learning management system (LMS) is totally different from the production of traditional textbooks. Certain theories of learning and theories of communication should be used as the base for the production of computer based LMS. It must provide an independent study and freedom to the learner. The theoretical overview of the computer based LMS are described below.
Framework review of the web based LMS

Many computer based LMS frameworks are presently available now. A review on these frameworks will definitely helps for the development of learning and evaluation framework of M-LMS. The context of this study was the development of an online learning environment on web-based education for secondary school pupils of Kerala.

Features needed for a good web based learning management system identified in the review are given below:

**Online participation**

A web based LMS tracks progress and performance and reveals students who do not log in to their online classroom or who log in without participating. Klemm (1998) blamed classroom-based teaching where students expect entertainment for conditioning them to passive learning. Therefore, they seldom realize the benefits of participating actively in online discussions, naturally lurking. Well-facilitated online discussions can be more inclusive than classroom discussions by including introvert students and enabling better quality interaction (Cox, Carr & Hall, 2004). Rovai and Barnum (2003) claimed that passive online learning through “listening” without participation produces no measurable increase in knowledge, as they could predict perceived learning through the number of messages posted.
Others have also reported that distributed students who participate in dynamic
discussions had better course completion rates and that failing students
interacted less frequently (Davies & Graff 2005; Swan, Elkin & Fenster,
2000). Active online participation also benefits learning.

**Improved learning**

It is another feature of web based LMS. The following studies support
capability of web based environments.

Collaborative learning activities contribute to deep learning, critical
thinking skills, shared understanding, and long-term retention (Garrison,
Anderson & Archer, 2001).

According to Cox *et al.* (2004), students who focused on building
knowledge and collaborative interactions had a superior average performance,
as challenging online interactions promote understanding. Interactive learning
provides an instructor with insight into student misconceptions, difficulties,
conceptual problems, and verbal pitfalls. Asking leading questions elicits
insights into what students understand, more than simply telling them the
answer. Immediate feedback from their peers and instructors and social
interaction built into the online discussions contribute to learning.
Deep cognitive learning and high levels of interactivity are possible in online discussions, as students can prepare well-considered contributions (Kettner and Polley, 2005).

The above three studies support that improved learning is a feature of web-based LMS.

**Community of learners**

Web based LMS can provide a virtual community of learners with any time anywhere communication facility. The following studies reveal the importance of community of learners.

Students in a healthy online community support their community (Collison, Elbaum, Haavind & Tinker, 2000). Their concern became evident when they contributed without expecting rewards. After concluding the course a request was e-mailed for feedback to clarify some outstanding issues. Voluntary responses indicated prolonged involvement in their community.

Interaction is conducive to the emergence of a community of practice and a virtual community of learners (Collison et al., 2000). Collaborative learning groups solve problems while sharing and clarifying ideas (Cox et al., 2004). In a collaborative learning environment student develop critical thinking skills and a shared understanding and deep learning, while retaining learning over the long term. In a community of practice novices learn from
experts by observing authentic tasks and executing progressively more advanced tasks themselves under an expert eye (Johnson, C. S., 2001).

Complex tasks can be learnt in a community of practice wherein “participants actively communicate about and engage in the skills involved in expertise” (Collins, Brown & Holum, 1991). Frequent, meaningful, valued, and dynamic discussions in an online course lead to the formation of a virtual learning community where students interact and support each other. According to Collison et al. (2000), members of a healthy online community of learners post regularly and collaborate with other participants, as well as teach and moderate the online discussions spontaneously. Group cohesion, trust, respect, and a sense of belongingness further characterize a community of learning (Kreijns, Kirschner & Jochems, 2003). The formation of a community cannot be taken for granted. Some students do not participate fully.

**Facilitator participation**

Of course, like other learning environments, web based learning LMS can also provide facilitator participation. Which makes the facilitator more accountable than facilitator in a non-computer based LMSs. Student interaction is not the only factor influencing collaboration, learning, and successful course completion. Students become more involved in an online conference when the facilitator participates as a guide, providing extensive
criticism, feedback, and encouragement. The importance of facilitator in a learning environment is explained in the following studies.

An effective learning community requires an instructor with integrated social, cognitive, and teaching presence (Cox *et al.*, 2004). Facilitators should teach critical thinking, effective communication, and problem-solving skills (Shavelson & Huang, 2003). The current vogue to embrace constructivist pedagogy, where, the instructor withdraws from the online learning environment, allegedly to promote discovery and experimental learning activities, is unsubstantiated (Kirschner, Sweller & Clark, 2006).

In the study ‘Read only participants: a case for student communication in online classes’ (Nagel, Blignaut & Cronje, 2007), the students were communicated with the facilitator by e-mail and short text messages. The distributed student with the intermittent electricity supply reported these by short text message or telephone and thus negotiated deadlines. A few communicated to the facilitator in personal circumstances that precluded class participation and accommodated them by allowing them to work separately. Their interaction with the facilitator possibly contributed to their success (King, 2002).

In a predominantly participative class, the number of times students access the course, the number of contributions to discussions, the ratio of replies to others’ posts, and integration into the learning community all
significantly relate to successful course completion. These metrics, however, have poor individual predictive value because the great diversity of students in the cohort included numerous exceptions.

**Discussion posts**

Giving compulsory discussion posts and providing a view on peer group contributions can identify the extent of student participation in a web based Learning environment. Studies indicated a significant difference between the numbers of postings from the students in different grade groups. Successful students replied two or three times more often to other posts than they initiated original posts.

**Quality participation**

Klemm (1998) proposed using peer groups to grade the value of each person’s contribution. Therefore, team assignment to develop a rubric for scoring online collaborative behaviour is a must. The collaboration score will be average of assessments by two peers and the facilitator using this rubric. While rudimentary, it indicates how students rated others’ participation. Like all previously discussed quantitative measurements of student activity in the online classroom, the collaboration score showed highly significant differences among the three stratifications of students, as unsuccessful
students had low collaboration scores and the highly successful ones scored the highest.

It also used peer review extensively as a mechanism to improve interaction and learn collaboratively (Boud, Cohen & Sampson, 1999). The transparent learning gave students insight into each other’s work. Most students were positive about the peer assessment process and realized the advantages.

**Group participation**

Cooperative group assignments encourage students to participate online learning. Nagel et al. (2007) scheduled group assignments and allocated a small portion of the grades to the activities in their study ‘Read-only participants: a case for student communication in online classes’. The rationale for using group work was teaching students the challenges of working in distributed online groups. Despite online support in the form of dedicated discussion groups and synchronous chat rooms to ease the management of their assignments, some students participated insufficiently and created discontent. Numerous students indicated teamwork as the biggest challenge in the course.

A core of students represented a high functioning, healthy online community (Collison et al., 2000). The ethnography showed the concern and
support that existed in this community, with students informing their peers of imminent absence from discussions. Reasons for absence were often work related, teachers attending conferences or school tours, for example. Students were also willing to be vulnerable (Barab, Thomas & Merrill, 2001) and shared personal circumstances, like serious illness, road accidents, and death among close associates. By extending support, close affective bonds and a camaraderie developed. This resembled Barab et al.’s (2001) community, where “students readily shared their feelings, critically examined course issues, extended their support in helping peers.” High quality contributions granted membership to the community. The community in turn helped students to improve the quality of their contributions in a positive feedback fashion. The community was not inclusive. At its core students participated often, while at the periphery individuals participated less.

Component review of the web based LMS

This section of theoretical overview deals with the components that are needed for the development of a web based LMS. A good web based LMS can be capable of handling individual activities, group activities and evaluation mechanisms. Thus, software components to achieve these activities were searched during this review. The software component reviews in each category are explained below.
Individual activity components reviewed for web based LMS

The investigator reviewed many web based individual activities available (www.ukonot.ac.uk/nof/support/workshops/2001/materials/learning/learning_interact_guideline.html). Some of them are given below.

*Interactive learning materials*

Well furnished Interactive Learning Materials can work as a individual activity component of a web based LMS. The speed, accuracy, and the number of trials taken to complete the learning activity can be assessed using interactive learning material. The teachers themselves can add the contents to the interactive software with the help of a sub component included in it. The features of Interactive Learning Materials reviewed are explained below.

An interactive educational resource should offer users the opportunity to experience information in a unique way, using the electronic medium to add value to the content, and offering more than a conventional printed resource. Interactivity in an electronic educational resource can be experienced online in a variety of ways as explained below.

Navigation

Navigation is the starting point of any good electronic resource and must be developed carefully in order to ensure that materials are structured in
an easy to use format appropriate for the target audience. It is good practice to include a site map, outlining content and routes to access it so that users can always locate their position within a website or other resources. The electronic format enables the user to access information in a variety of ways. A good navigation should provide greater flexibility in the use and retrieval of the material.

Reading materials

It is important that both the font and length of text are appropriate for the target age group. The font used should be one that is clearly legible on screen, and offers good examples of letter formation. The font style and colour should be configurable to suit a range of visual abilities. Text should be clearly laid out in short sentences and bullet pointed wherever possible. The probable reading ability and vocabulary of the audience should also be considered.

Visuals

Visuals include still images, video clips and illustrations. These should both enhance the page and have a specific purpose. There should be a balance between visuals and text on a page. All visuals should be captioned to highlight their relevance or to ask the user to reflect on what they see.
Questions

A variety of different types of questions can encourage and reinforce user’s learning. The format for questions ranges from multiple choice and fill in the blank to hotspots and drag and drop. Answers can also be displayed in a variety of ways such as in a visual form, text based pop up window or accompanied by sound.

An interactive resource should provide users with feedback on their answers. If questions have a clear ‘right or wrong’ answer, users must be offered the opportunity to try again and succeed. Immediate feedback ensures that the user remains fully engaged with the activity. This motivates users to complete the activity and to revisit at a later date.

Exploring

The electronic medium enables a user to explore an image or illustration to discover further information. The medium offers an added depth that can help to highlight key facts and issues in a quick, simple but effective way.

Icons and characters

Icons and characters can serve a variety of useful purposes. Apart from providing clear and simple navigation, they can offer easy reference points for users and help them to identify key tools. This might be through a
character representing a different subject, an icon providing a help facility, or a symbol denoting where to find further information. Icons and characters should serve a purpose other than decoration. Icons should be large enough to allow easy positioning of the cursor and should be clearly labelled. Navigation icons such as the exit button should be in the same place on every screen.

Element of fun

Games and puzzles offer users the opportunity to have fun and learn simultaneously. This is an ideal way of reinforcing learning. Games have the advantage of offering different types of learning opportunities and can allow for information to be accessed in a unique and absorbing way.

Striking a balance

It is often useful to strike a balance between online and offline content, and to provide links to other work and information sources. Online activities provide a good way of introducing themes or topics to the user. They can provide additional interest and discussion in a formal or informal setting like in the classroom, at home, with parents, with friends, etc.

Differentiation and progression

An online resource can provide differentiation and progression for user’s abilities. It should offer learners opportunities to work at different
levels of challenge, in terms of both the reading level of the text and the user’s engagement with the content. Differentiation can be by task, by the level and nature of support provided, and by the range of resources or information available.

The Interactive Learning Material which is to be developed in the proposed software will also provide all the above features.

**Reference material and tutorials**

Computer based Reference Materials include Websites, Presentations, Directories, and electronic and online encyclopaedias. These materials can be provided in online and offline mode in any LMS for reference. These are detailed below.

**Web-pages**

A web page is a document or information resource that is suitable for the World Wide Web and can be accessed through a web browser and displayed on a monitor or a projector. This information is usually in HTML or XHTML format, and may provide navigation to other web pages via hypertext links. Web pages frequently subsume other resources such as style sheets, scripts and images into their final presentation.
Presentations

Any software program for creating graphic presentations with visual aids, handouts, slides, etc. are called Presentation software. Software for creating text with graphics, audio, and/or video are called presentation graphics. Presentation software used, to display information, is normally in the form of a slide show.

Directories

Directories are collections of resources organised into categories. Sometimes the directory will focus on one subject area, others may collect and organise resources in a number of areas.

Online/electronic Encyclopaedias

An encyclopedia on the Internet to which everyone could contribute materials. It is a large database of useful information, accessible via the World Wide Web.

The above mentioned reference materials and tutorials have the ability to work as a individual activity component in a web based LMS. The materials may be downloadable or in HTML format.
Chat-room facility

Chat room facility is another software component that provides individual initiations and responses. So, it can be used for individual participation assessment in an LMS. A 'chat room' is a Web site, part of a Web site, or part of an online service, that provides a venue for communities of users with a common interest to communicate in real time. Chat room users register for the chat room of their choice, choose a user name and password, and log into a particular room. Inside the chat room, generally there is a list of the people currently online, who also are alerted that another person has entered the chat room. To chat, users type a message into a text box. The message is almost immediately visible in the message area and other users respond. Users can enter chat rooms and read messages without sending any, a practice known as lurking. Chat rooms can be found that focus on virtually any aspect of human endeavour or interest.

The primary use of a chat room is to share information via text with a group of other users. Generally speaking, the ability to converse with multiple people in the same conversation differentiates chat rooms from instant messaging programs, which are more typically designed for one-to-one communication. The users in a particular chat room are generally connected via a shared interest or other similar connection, and chat rooms exist catering
for a wide range of subjects. New technology has enabled the use of file sharing and web-cams to be included in some programs.

**Blog-based assignments**

Blog-based assessments are another powerful computer-based solution to express individual capabilities. It is also used for the assessment of individual performance. Blog is a website that contains an online personal journal with reflections, comments, and often hyper links provided by the writer. Blogs are usually maintained by an individual with regular entries of commentary, descriptions of events, or other materials such as graphics or video. Most blogs are interactive, allowing visitors to leave comments and even message each other via widgets on the blogs and it is this interactivity that distinguishes them from other static websites. Using the present software the students can develop blogs of their own interest based on the classroom discussions which also be evaluated as an individual activity.

**E-mails as individual activity component**

By using the e-mail facility the students can share their collections, important web-links, etc suited to the topics which are discussed in the classroom. This service also helps to communicate and clear their doubts with teachers. Thus, it can also work as an individual activity component in a web based LMS.
The facilities such as chat, blogs and e-mail will provide the following features.

Discussion

A good educational resource has the potential to encourage discussion between users either while working at the computer or later offline. Discussion can take many forms such as:

- users collaborating to answer a question
- discussing and exchanging ideas about a point or issue raised by the information on screen
- negotiating whose turn it is to input data
- a conversation about where or how to explore further
- develop further opportunities offline to discuss issues/questions raised by work done at the computer.

Participation

Electronic resources provide opportunities for users to not only interact with the computer but also interact with other people. The communicative function of computers provides one of their most powerful educational applications. Users can share ideas, information and opinions through such activities as participation in a moderated forum, ‘ask the expert’, email, and online debate.
Each of these individual activities described above are useful components for a web based LMS environment.

**Group activity components reviewed for web based LMS**

Individual activities as well as group activities are important in any modern learning management system. So, web based group activities can also have a component of web based LMS. The participation in group activities can be assessed by analysing the pupils’ communication with others through computer medium. There exist four types of computer mediated communications. The four types of computer mediated communications include one alone, one to one, one to many, many to many communications using computers.

A variety of web based group activities are available now. Discussion Forums, Wiki, Online Conferences, and class blog are among them. These are detailed below.

*Discussion forum*

Discussion forum is a facility in which people can hold conversations in the form of posted messages. The students and teachers can start a forum based discussion on their subject matter using this facility. The forum entries generated by the members can be then evaluates to assess the participation of
students in the forums, started by teachers and their self initiated forums as well.

**Wiki Editing and development**

Wiki is a type of web site which is usually developed collaboratively by a community of users, allowing any user to add and edit content. The student groups can develop a wiki page based on the topic of discussion. The provisions to evaluate each student’s role in the creation of Wiki also can be evaluated.

**Class blogs and subject blogs**

Class blogging is a web based technique that is used to provide group activities. Class blogs are not treated as individual blogs. All the pupils have provisions to put their own entries into the class blog or subject blog. Unlike individual blogs class blogs and subject blogs are maintained by the class, not by the individual. Through class blogs it can be analysed the area of interest of the pupils by assessing the head they selected.

Some components discussed in the individual activity review are also used for Group Participation Assessment. That includes e-mails and chatting among individuals with the teachers and peers. These assessments also can be combined with other group activity components to get overall performance in group activity.
Software components for the above mentioned facilities can be included as group activity components in any web based LMS. The evaluation and scoring of the performance of the pupils may be more accountable using these components.

**Blogs**

A blog, a blend of the term web log, is a type of website or part of a website. Blogs are usually maintained by an individual with regular entries of commentary, descriptions of events, or other material such as graphics or video. Entries are commonly displayed in reverse-chronological order. Blog can also be used as a verb, meaning to maintain or add content to a blog.

Most blogs are interactive, allowing visitors to leave comments and even message each other via widgets on the blogs and it is this interactivity that distinguishes them from other static websites.

Many blogs provide commentary or news on a particular subject; others function as more personal online diaries. A typical blog combines text, images, and links to other blogs, Web pages, and other media related to its topic. The ability of readers to leave comments in an interactive format is an important part of many blogs. Most blogs are primarily textual, although some focus on art (Art blog), photographs (photo blog), videos (video
blogging), music (MP3 blog), and audio (podcasting). Microblogging is another type of blogging, featuring very short posts.

**Email as group activity component**

Electronic mail, commonly called email or e-mail, is a method of exchanging digital messages from an author to one or more recipients. Modern email operates across the Internet or other computer networks. Some early email systems required that the author and the recipient both be online at the same time. Today's email systems are based on a store-and-forward model. Email servers accept, forward, deliver and store messages. Neither the users nor their computers are required to be online simultaneously; they need connect only briefly, typically to an email server, for as long as it takes to send or receive messages.

An email message consists of three components, the message *envelope*, the message *header*, and the message *body*. The message header contains control information, including, minimally, an originator's email address and one or more recipient addresses. Usually descriptive information is also added, such as a subject header field and a message submission date/time stamp.
Chat-room

Chat is a way of communicating by sending text messages to people in the same chat-room in real-time. Some chat rooms such as Gmail, Yahoo!, etc, use both text, voice and video simultaneously. The oldest form of true chat rooms are the text-based variety. So the analysis of sites like gmail, Yahoo messenger, Orkut, Facebook, etc are used to review the current trends in chatting.

Evaluation mechanisms reviewed for web based LMS

Evaluation mechanisms are also considered as an unavoidable part of a learning management system. The present study is the development of a web based LMS. Thus, some Information Communication Technology (ICT) enabled evaluation mechanisms must be come for the management of all evaluation procedures included in the LMS.

The following are some evaluation mechanisms used on different web based learning management systems.

Speed counter

Using this facility it can be assessed the time taken by the pupil for completing the activities included in the LMS. It works with the support of a timer programme. Timer programme can be created using programming languages. In a web based environment web based programming languages
are useful for the making of speed counter.

**Trial counter**

This is another evaluation component that is useful in a web based LMS. This facility helps to count number of trials taken by the pupil to complete an interactive activity and to store it into a database. It can be developed by using a web based programming language.

**Hit counter**

This facility assesses the group cohesion and place of an individual in a group. With the help of Hit Counters provided, it can easily evaluate the position of an individual among his peers.

**Teacher controlled entry-form**

The teacher can enter the details of the students into the software directly using Teacher Controlled Entry-form (TCE). The teachers’ entry include the attendance of the pupil, grade awarded to pupils by the teacher for participation in discussions, achievements in extracurricular activities, etc.

**Computer managed tests**

Computer managed tests are used to assess the learners, based on a predefined blue print, with help of electronic medium like computers. Different content authoring software are available in the web for test construction.
Utilisation of these types of software components helps a learning management system for summative and formative evaluations.

**Theoretical basis of the web based LMS**

The major theories influencing the production of web based LMS and their implications are given below. The learning theories such as behaviorist theory like Drive reduction theory (Hull, 1943); Cognitive approaches like Constructivist theory (Bruner, 1966; Piaget, 1972); Hierarchy of Learning (Gagne, 1962); Classification of learning outcomes (Bloom, 1956); Gestalt theory (Wertheimer, 1959); Mathematical learning theory (Atkinson, 1972); Information pick up theory (Gibson, 1977); Social Constructivism; and issue based learning have implications in developing web based LMS.

**Drive reduction theory**

Hull’s system of learning (1943) is acclaimed and remembered for putting forward a most systematic, scientific and mathematical theory of learning. Hull’s theory gives more importance to the needs, drives, incentives, reinforcement and adequate motivation for achieving satisfactory results in the process of learning. Hull’s theory brought into focus the fact that different individuals have different capacities.
**Gestalt theory**

One of the principal proponents of Gestalt theory was Wertheimer (1959). His theory emphasized higher order cognitive process. Wertheimer was especially concerned with problem solving. The essence of successful problem solving according to Wertheimer is being able to see the overall structure of the problem. According to this theory the learner should be encouraged to discover the underlying nature of a topic or problem and the instruction should be based upon the laws of organization—proximity, closure, similarity and simplicity.

**Hierarchy of learning**

Gagne (1962) suggests that learning task for intellectual skills can be organized in a hierarchy according to complexity. According to Gagne the following sequence is effective in self-instruction.

- Gaining attention.
- Informing learners of the objectives.
- Stimulating recall of prior learning.
- Presenting the stimulus.
- Providing learning guidance.
- Electing performance.
- Providing feedback.
• Accessing performance.

• Enhancing retention and transfer.

**Constructivist theory**

The major theme in the theoretical framework of Bruner (1966) and Piaget (1972) is that learning is an active process in which learner construct new ideas or concepts based upon their current or past knowledge. As far as instruction is concerned, the instructor should try and encourage students to discover the principles by themselves. Instruction should be structured and or organized in a spiral manner so that the learner continuously builds upon what they have already learned.

**Classification of learning outcomes**

Bloom (1970) developed a classification of intellectual behaviour which is attempted to classify forms and levels of learning which is later modified by Anderson and Krathwohl in 2001. This became taxonomy of three overlapping domains-The cognitive, affective and psycho-motor. Cognitive domain deals with intellectual abilities, affective domain deals with the emotional development and psycho-motor domain includes physical skills.
Mathematical learning theory

Mathematical learning theory is an attempt to describe and explain behaviour in quantitative terms. Atkinson (1972) discusses the problem of optimizing instructions. This theory gives stress to develop an optimal instructional strategy for a given individual provided that a detailed model of the learning process is available. According to this theory optimal learning performance can be achieved by giving each individual sufficient time to learn.

Information pickup theory

The information pickup theory suggests that perception depends entirely upon information in the ‘stimulus array’. This theory was proposed by Gibson (1977). According to this theory contents should be relevant to the receiver and according to the needs of the learners.

Social constructivism

Social constructivism emphasizes the importance of culture and context in understanding what occurs in society and constructing knowledge based on this understanding (Derry, 1999). This perspective is closely associated with many contemporary theories, most notably the developmental theories of Vygotsky (1978) and Bruner (1966), and Bandura's (1977) social cognitive theory (Schunk, 2000).
Social constructivism is based on specific assumptions about reality, knowledge, and learning. To understand and apply models of instruction that are rooted in the perspectives of social constructivists, it is important to know the premises that underlie them. Social constructivists believe that reality is constructed through human activity. Members of a society together invent the properties of the world (Kukla, 2000). For the social constructivist, reality cannot be discovered: it does not exist prior to its social invention. To social constructivists, knowledge is also a human product, and is socially and culturally constructed (Ernest, 1999; Gredler, 1997). Individuals create meaning through their interactions with each other and with the environment they live in. Social constructivists view learning as a social process. It does not take place only within an individual, nor is it a passive development of behaviors that are shaped by external forces (McMahon, 1997). Meaningful learning occurs when individuals are engaged in social activities.

Social constructivism is closely related to social constructionism in the sense that people are working together to construct artifacts. However, there is an important difference: social constructionism focuses on the artifacts that are created through the social interactions of a group, while social constructivism focuses on an individual's learning that takes place because of their interactions in a group.
Constructivism forms one of the major theories of child development, arising from the work of Piaget's theory of cognitive development (1972). Piaget's stage theory (describing four successive stages of development) also became known as constructivism, because he believed children needed to construct an understanding of the world for themselves. Social constructivism extends constructivism by incorporating the role of other actors and culture in development. In this sense it can also be contrasted with social learning theory by stressing interaction over observation. Social constructivism has been studied by many educational psychologists, who are concerned with its implications for teaching and learning.

Vygotsky's contributions reside in *Mind in Society* (1978) and *Thought and Language* (1986). Vygotsky independently came to the same conclusions as Piaget regarding the constructive nature of development.

An instructional strategy grounded in social constructivism that is an area of active research is *computer-supported collaborative learning (CSCL)*. This strategy gives students opportunities to practice 21st-century skills in communication, knowledge sharing, critical thinking and use of relevant technologies found in the workplace.

Additionally, studies on increasing the use of student discussion in the classroom both support and are grounded in theories of social constructivism. There is a full range of advantages that result from the implementation of
discussion in the classroom. Participation in group discussion allows students to generalize and transfer their knowledge of classroom learning and builds a strong foundation for communicating ideas orally (Reznitskaya, Anderson & Kuo, 2007). Many studies argue that discussion plays a vital role in increasing student ability to test their ideas, synthesize the ideas of others, and build deeper understanding of what they are learning (Corden, 2001; Nystrand, 1996; Reznitskaya, Anderson & Kuo, 2007; Weber, Maher, Powell & Lee, 2008). Large and small group discussion also affords students opportunities to exercise self-regulation, self-determination, and a desire to persevere with tasks (Corden, 2001; Matsumura, Slater & Crosson, 2008). Additionally, discussion increases student motivation, collaborative skills, and the ability to problem solve (Dyson, 2004; Matsumura, Slater & Crosson, 2008; Nystrand, 1996). Increasing students’ opportunity to talk with one another and discuss their ideas increases their ability to support their thinking, develop reasoning skills, and to argue their opinions persuasively and respectfully (Reznitskaya, Anderson & Kuo, 2007). Furthermore, the feeling of community and collaboration in classrooms increases through offering more chances for students to talk together (Barab, Dodge, Thomas, Jackson & Tuzun, 2007; Hale & City, 2002; Weber, Maher, Powell & Lee, 2008).
Software Review

Software review is also important in a software development work. The details of reviewed software are given below.

**Modular object oriented dynamic learning environment (MOODLE)**

The word MOODLE is originally an acronym for Modular Object-Oriented Dynamic Learning Environment, which is mostly useful to programmers and education theorists (https://moodle.org). It is also a verb that describes the process of lazily meandering through something, doing things as it occurs to do an enjoyable tinkering that often leads to insight and creativity. As such it applies both to the way MOODLE was developed, and to the way a student or teacher might approach studying or teaching an online course. Anyone who uses MOODLE is a Moodler.

MOODLE is a software package for producing Internet-based courses and websites. It is a global development project designed to support a *social constructionist* framework of education.

MOODLE is an Open Source Course Management System (CMS), also known as a Learning Management System (LMS) or a Virtual Learning Environment (VLE). It has become very popular among educators around the world as a tool for creating online dynamic web sites for their students. To
work, it needs to be installed on a web server somewhere, either on one of your own computers or one at a web hosting company.

The focus of the MOODLE project is always on giving educators the best tools to manage and promote learning, but there are many ways to use Moodle:

- MOODLE has features that allow it to scale to very large deployments and hundreds of thousands of students, yet it can also be used for a primary school or an education hobbyist.
- Many institutions use it as their platform to conduct fully online courses, while some use it simply to augment face-to-face courses (known as blended learning).
- Many of the users love to use the activity modules (such as forums, databases and wikis) to build richly collaborative communities of learning around their subject matter (in the social constructionist tradition), while others prefer to use MOODLE as a way to deliver content to students and assess learning using assignments or quizzes.

MOODLE can be installed on any computer that can run PHP, and can support an SQL type database like MySQL. It can be run on Windows and Mac operating systems and many flavors of linux like Red Hat or Debian GNU. GNU Linux is now familiar in Kerala schools. There are many knowledgeable Moodle partners to assist and even host a new MOODLE site.
The design and development of MOODLE is guided by social constructionist pedagogy. This concept is explained below in terms of four main, related concepts: constructivism, constructionism, social constructivism, and connected and separate.

From a constructivist point of view, people actively construct new knowledge as they interact with their environments.

Everything read, see, hear, feel, and touch is tested against prior knowledge and if it is viable within the mental world, may form new knowledge one carries with him. Knowledge is strengthened if an individual can use it successfully in his wider environment. Pupils are not just a memory bank passively absorbing information, nor can knowledge be "transmitted" to them just by reading something or listening to someone.

This is not to say one can't learn anything from reading a web page or watching a lecture, obviously one can, it's just pointing out that there is more interpretation going on than a transfer of information from one brain to another.

Constructionism asserts that learning is particularly effective when constructing something for others to experience. This can be anything from a spoken sentence or an internet posting, to more complex artifacts like a painting, a house or a software package.
For example, pupils might read this page several times and still forget it by tomorrow - but if they were to try and explain these ideas to someone else in his own words, or produce a slideshow that explained these concepts, then it is very likely they would have a better understanding that is more integrated into their own ideas. This is why people take notes during lectures even if they never read the notes again.

Social constructivism extends constructivism into social settings, wherein groups construct knowledge for one another, collaboratively creating a small culture of shared artifacts with shared meanings. When one is immersed within a culture like this, one is learning all the time about how to be a part of that culture, on many levels.

A very simple example is an object like a cup. The object can be used for many things, but its shape does suggest some knowledge about carrying liquids. A more complex example is an online course - not only do the shapes of the software tools indicate certain things about the way online courses should work, but the activities and texts produced within the group as a whole will help shape how each person behaves within that group.

**Connected and separate learning environments**

This idea looks deeper into the motivations of individuals within a discussion:
Separate behaviour is when someone tries to remain objective and factual, and tends to defend their own ideas using logic to find holes in their opponent's ideas.

Connected behaviour is a more empathic approach that accepts subjectivity, trying to listen and ask questions in an effort to understand the other point of view.

Constructed behaviour is when a person is sensitive to both of these approaches and is able to choose either of them as appropriate to the current situation.

In general, a healthy amount of connected behaviour within a learning community is a very powerful stimulant for learning, not only bringing people closer together but promoting deeper reflection and re-examination of their existing beliefs.

Consideration of these issues can help to focus on the experiences that would be best for learning from the learner's point of view, rather than just publishing and assessing the information you think they need to know. It can also help you realise how each participant in a course can be a teacher as well as a learner. Your job as a 'teacher' can change from being 'the source of knowledge' to being an influencer and role model of class culture, connecting with students in a personal way that addresses their own learning needs, and
moderating discussions and activities in a way that collectively leads students towards the learning goals of the class.

MOODLE does not force this style of behaviour, but this is what the designers believe that it is best at supporting. In future, as the technical infrastructure of MOODLE stabilises, further improvements in pedagogical support will be a major direction for MOODLE development.

KStars

KStars is a Desktop Planetarium software for K Desktop Environment (KDE). KDE is a powerful graphical desktop environment for UNIX workstations. KStars provides an accurate graphical simulation of the night sky, from any location on Earth, at any date and time. The display includes upto 100 million stars, 13,000 deep-sky objects, all 8 planets, the Sun and Moon, and thousands of comets and asteroids (https://edu.kde.org/kstars).

KStars is a graphical desktop planetarium for KDE. It depicts an accurate simulation of the night sky, including stars, constellations, star clusters, nebulae, galaxies, all planets, the Sun, the Moon, comets and asteroids. One can see the sky as it appears from any location on Earth, on any date. The user interface is highly intuitive and flexible; the display can be panned and zoomed with the mouse, and can easily identify objects, and track
their motion across the sky. KStars includes many powerful features, yet the interface is clean and simple, and fun to use.

KStars lets one to explore the night sky from the comfort of his computer chair. It provides an accurate graphical representation of the night sky for any date, from any location on Earth. The display includes 126,000 stars to 9th magnitude (well below the naked-eye limit), 13,000 deep-sky objects (Messier, NGC, and IC catalogs), all planets, the Sun and Moon, hundreds of comets and asteroids, the Milky Way, 88 constellations, and guide lines such as the celestial equator, the horizon and the ecliptic.

From an object's popup menu, one can open its Detailed Information Window, where one can examine positional data about the object, and query a huge treasury of online databases for professional-grade astronomical data and literature references about the object. One can even attach his own Internet links, images and text notes, making KStars a graphical front-end to his observing logs and his personal astronomical notebook.

The Astrocalculator tool provides direct access to many of the algorithms the program uses behind the scenes, including coordinate converters and time calculators. The AAVSO Lightcurve Generator tool will download a lightcurve for any of the 6000+ variable stars monitored by the American Association of Variable Star Observers (AAVSO). The lightcurves
are generated “on the fly” by querying the AAVSO server directly, ensuring that the users have the very latest data points.

The users can plan an observing session using their Altitude vs. Time tool, which will plot curves representing the Altitude as a function of time for any group of objects. If that is too much detail, it also provides a What's Up Tonight? tool that summarizes the objects that the users will be able to see from your location on any given night. The users can add their favorite objects to the Observing List tool, which provides convenient access to common actions for a list of objects.

KStars also provides a Solar System Viewer, which shows the current configuration of the major planets in our solar system. There is also a Jupiter Moons Tool which shows the positions of Jupiter's four largest moons as a function of time.

KStars is an interactive educational tool for learning about astronomy and the night sky. To this end, the KStars Handbook includes the AstroInfo Project, a series of short, hyperlinked articles on astronomical topics that can be explored with KStars. In addition, KStars includes DBUS functions that allow to write complex scripts, making KStars a powerful "demo engine" for classroom use or general illustration of astronomical topics.
The users can control telescopes and cameras with KStars, using the elegant and powerful *INDI* protocol. KStars supports several popular telescopes including Meade's LX200 family and Celestron GPS. Several popular CCD cameras, webcams, and computerized focusers are also supported. Simple slew/track commands are integrated directly into the main window's popup menu, and the INDI Control Panel provides full access to all of telescope's functions. INDI's Client/Server architecture allows for seamless control of any number of *local* or *remote* telescopes using a single KStars session.

**PhET**

PhET provides fun, interactive, *research-based* simulations of physical phenomena for free. Its research-based approach- incorporating findings from prior research and its own testing- enables students to make connections between real-life phenomena and the underlying science, deepening their understanding and appreciation of the physical world (https://phet.colorado.edu/).

To help students visually comprehend concepts, PhET simulations animate what is invisible to the eye through the use of graphics and intuitive controls such as click-and-drag manipulation, sliders and radio buttons. In order to further encourage quantitative exploration, the simulations also offer measurement instruments including rulers, stop-watches, voltmeters and
thermometers. As the user manipulates these interactive tools, responses are immediately animated thus effectively illustrating cause-and-effect relationships as well as multiple linked representations (motion of the objects, graphs, number readouts, etc.)

To ensure educational effectiveness and usability, all of the simulations are extensively tested and evaluated. These tests include student interviews in addition to actual utilization of the simulations in a variety of settings, including lectures, group work, homework and lab work. The rating system indicates what level of testing has been completed on each simulation.

All PhET simulations are freely available from the PhET website and are easy to use and incorporate into the classroom. They are written in Java and Flash, and can be run using a standard web browser as long as Flash and Java are installed.

PHP

A web based programming language software is necessary for the development of web based Learning Management System software because, a web based programs that is hosted on Internet or local Intranet can provide anytime anywhere access to the pupil. Thus, the teacher can communicate with the pupils at on school hours as well as on non-school hours. (www.w3schools.com/php).
PHP is originally stood for *Personal Home Page*. It is also stand for *PHP: Hypertext Preprocessor*. It is a widely-used Open Source general-purpose scripting language that is especially suited for Web development and can be embedded into HTML. PHP can be deployed on most web servers and as a standalone interpreter, on almost every operating systems and platforms free of charge.

**MySQL**

The presence of a Database Management System (DBMS) can be seen in all computer managed educational software. The MySQL database has become the world's most popular open source database because of its high performance, high reliability and ease of use (https://mysql.com). It is also the database of choice for a new generation of applications built on the LAMP stack (Linux, Apache, MySQL, PHP / Perl / Python).

**Adobe Flash**

Adobe Flash is a multimedia platform used to add animation, video, and interactivity to web pages. Flash is frequently used for advertisements and games. More recently, it has been positioned as a tool for "Rich Internet Applications" (www.adobe.com/software/flash/about/).

Flash manipulates vector and raster graphics to provide animation of text, drawings, and still images. It supports bidirectional streaming of audio
and video, and it can capture user input via mouse, keyboard, microphone, and camera. Flash contains an object-oriented language called Action Script.

Flash content may be displayed on various computer systems and devices, using Adobe Flash Player, which is available free of charge for common web browsers, some mobile phones and a few other electronic devices.

Adobe Dreamweaver

Adobe Dreamweaver is a content management system. A content management system can speed up the software development process, especially the development of web based user interface.

Adobe Dreamweaver software empowers designers and developers to build standards-based websites. Design visually or directly in code, develop pages with content management systems, and posaccurately test browser compatibility (www.adobe.com/products/dreamwearer.html).

Dreamweaver allows users to preview websites in locally installed web browsers. It provides transfer and synchronization features, the ability to find and replace lines of text or code by search terms and regular expressions across the entire site, and a templating feature that allows single-source update of shared code and layout across entire sites without server-side includes or scripting. The behaviours panel also enables use of basic
JavaScript without any coding knowledge, and integration with Adobe's Spry Ajax framework offers easy access to dynamically-generated content and interfaces.

Social networking sites

A social network is a social structure made up of individuals (or organizations) called "nodes", which are tied (connected) by one or more specific types of interdependency, such as friendship, kinship, common interest, financial exchange, dislike, sexual relationships, or relationships of beliefs, knowledge or prestige (https://wikipedia.org/wiki/social_networking_service).

Social network analysis views social relationships in terms of network theory consisting of nodes and ties (also called edges, links, or connections). Nodes are the individual actors within the networks, and ties are the relationships between the actors. The resulting graph-based structures are often very complex. There can be many kinds of ties between the nodes. Research in a number of academic fields has shown that social networks operate on many levels, from families up to the level of nations, and play a critical role in determining the way problems are solved, organizations are run, and the degree to which individuals succeed in achieving their goals.
In its simplest form, a social network is a map of specified ties, such as friendship, between the nodes being studied. The nodes to which an individual is thus connected are the social contacts of that individual. The network can also be used to measure social capital – the value that an individual gets from the social network. These concepts are often displayed in a social network diagram, where nodes are the points and ties are the lines.

**Review of Related Studies**

The investigator has made an extensive survey of studies related to the use of computers in education, the studies related to individualized/self learning and studies on interactive and online learning environments. A summary of the studies reviewed is presented in this section.

**Studies on the use of computers in education**

Young (1996) conducted a related study ‘The effect of self-regulated learning strategies on performance in learner controlled computer-based instruction’. The purpose of this study was to examine the effect of Self-Regulated Learning Strategies (SRLS) on performance in a learner-controlled and a program-controlled Computer-Based Instruction (CBI). SRLS was measured using a self-regulated learning strategies questionnaire. Seventh-grade subjects were divided into high and low levels of SRLS and then randomly assigned to one of two versions of a CBI lesson: one allowing
learner control over the sequence and content of the instruction and the other having the learners follow a linear instructional sequence. Results revealed that the performance differences between learners with high SRLS and those with low SRLS were greater under learner control than under program control (p<.05). Poor performance by subjects with low SRLS under learner control indicates a strong need for learners to possess self-regulatory learning strategies to achieve success under learner control. Program control, however, seems to minimize the performance differences between low and high levels of SRLS.

A study was conducted by Çepni, Taş & Kose (2006) under the title ‘The effects of computer-assisted material on students' cognitive levels, misconceptions and attitudes towards science’. The purpose of this study was to investigate the effects of a Computer-assisted Instruction Material (CAIM) related to "photosynthesis" topic on student cognitive development, misconceptions and attitudes. The study conducted in 2002-2003 academic year and was carried out in two different classes taught by the same teacher, in which there were fifty two IX\textsuperscript{th} grade high school students, in central city of Trabzon in Turkey. An experimental research design including the photosynthesis achievement test (PAT), the photosynthesis concept test (PCT) and science attitude scale (SAS) was applied at the beginning and at the end of the research as pre-test and post-test. The result showed that using CAIM
in teaching photosynthesis topic was very effective for students to reach comprehension and application levels of cognitive domain.

The study under the title 'Evaluation of Formative Computer-Based Assessment by Cell Biology Students with Differing Entry Qualifications and Ethnicity' by Bax (2006) was carried out to examine students' responses to the use of on-line assessments that included feedback. First year BSc students taking a Cell Biology module undertook such an assessment and were then asked to evaluate the test by completing an anonymous questionnaire. Answers were analysed in light of the respondents' ethnicity and also the academic route by which they gained entry to university. Statistical analysis of the data showed that students' views of the utility of the test did not differ significantly either as a function of ethnicity or academic experience, since 80-90% of the students agreed/strongly agreed that regular tests and feedback assisted in their learning process. Generally, it was noted that non-Caucasian population, especially the Black African group strongly agreed that the test exercise benefited their learning experience. In conclusion, asynchronous on-line formative tests which provide feedback are valuable learning aids for students from a wide variety of backgrounds.

The paper 'An Evaluation of the Webquest as a Computer-Based Learning Tool' by Hassanien (2006) explores the preparation and use of an internet activity for undergraduate learners in higher education (HE). It
evaluates the effectiveness of using webquest as a computer-based learning (CBL) tool to support students to learn in HE. The evaluation undertaken offers insights into learner perceptions concerning the ease of use of the webquest, the success of the learning experience and the adequacy of the interaction and engagement afforded. Although displaying some significant strengths, the webquest design could be further enhanced to offer an additionally enriched learning environment. Importantly, the strengths and weaknesses identified by the learners serve to highlight issues which university teachers and others need to take into account in order to serve the needs of learners using such CBL tool. The findings revealed that students considered that the webquest significantly enhanced their learning. Promising directions for future development are also identified.

The study entitled 'Design Issues Related to the Evaluation of Learner-Computer Interaction in a Web-Based Environment: Activities v. Tasks ' by Hemard (2006) is also a valuable one in this field. If web-based technology is increasingly becoming the central plank of contemporary teaching and learning processes, there is still too little evidence to suggest that it is delivering purposeful learning activities beyond its widely perceived potential as a learning resource providing content and learning objects. This is due in part to the "bandwagon" effect created by the popularity of the web but also because e-learning is being institutionally managed and pedagogically
harnessed without serious design considerations being given to its interactive specificity, which only seem to manifest themselves through sporadic and mainly inconsequential evaluation. On this premise, this paper attempts to identify some of the main design issues involved at both conceptual and implementation levels whilst making the case for the necessary collection and subsequent analysis of valid data. Therefore, it will re-examine the role, value and means of exploitation of existing evaluative data within the design process in order to facilitate the adoption of a more appropriate conceptual approach and to better understand web-based interaction in relation to learner requirements through the application of activity theory. The ulterior motive behind this study is to show the importance and relevance of the conceptual understanding of the web as a learning interactive construct and how the learning process it is meant to generate, can be improved through targeted and integrated evaluation.

The paper 'Multi-Attribute Utility Theory and Adaptive Techniques for Intelligent Web-Based Educational Software' by Kabassi and Virvou (2006), describes how the Multi-Attribute Utility Theory can be combined with adaptive techniques to improve individualised teaching in an Intelligent Learning Environment (ILE). The ILE is called Web F-SMILE, it operates over the Web and is meant to help novice users learn basic skills of computer use. Tutoring is dynamically adapted to the individual learner based on the
learner modelling component of the system and the Multi-Attribute Utility Theory (MAUT) that is employed to process the information about the user. As a result, MAUT provides a way for the system to select on the fly the best possible advice to be presented to users. Advice is dynamically formed based on adaptive presentation techniques, where adaptation is performed at the content level and adaptive navigation support, which is performed at the link level of the hyperspace of the tutoring system. The adaptivity of learning depends on factors such as the learner's habits, prior knowledge and skills, which are used as criteria for the application of MAUT in the educational software. In this way, a novel combination of MAUT with adaptive techniques is used for intelligent web-based tutoring.

In ‘Reframing Accountability: Using Performance Assessments to Focus Learning on Higher-Order Skills,’ Pecheone and Darling-Hammond (2009) of the School Redesign Network at Stanford University discuss how performance assessments can help evaluate students' ability to apply their knowledge and encourage teaching and learning of higher-order skills. They describe what performance assessments are and how they can benefit instruction, how they are being used to support policy goals in the United States and abroad, the major challenges and considerations that must be addressed to use performance assessments well, and how federal policy can
support the development and implementation of high-quality assessments that both support and evaluate more complex knowledge and skills.

In ‘Formative Assessment and Assessment for Learning,’ Stephen and Stiggins (2009) of the ETS Assessment Training Institute describe the characteristics of formative assessment, with a particular focus on those formative assessment practices that engage and empower students in their own learning, or assessments for learning. They also describe challenges related to the effective use of formative assessment and recommended actions for policymakers.

In ‘The Role of Interim Assessments in a Comprehensive Assessment System,’ Wurtzel, of the Aspen Institute, and Perie (2009), Marion, and Gong of the National Center for the Improvement of Education Assessment, United States, differentiate between true classroom formative assessment and the interim assessments currently in the marketplace. They then provide a framework for considering the appropriate role of interim assessments.

In ‘International Assessments of Student Learning Outcomes,’ Schleicher (2009) provides a brief introduction of the history of international assessments and describes the potential benefits of international assessments for educational policy and practice. He discusses some of the methodological challenges faced in providing valid, comparable, and reliable evidence, and offers recommendations to U.S. policymakers.
In ‘Measuring Student Achievement Growth at the High School Level,’ Martineau (2009) explains the technical underpinnings of growth models, describes the various types of growth models, articulates challenges inherent to measuring growth at the high school level, and explores implications for policymakers interested in moving towards the widespread use of growth models.

Abedi (2009) describes, in his paper ‘Assessing High School English Language Learners’, describes the challenges inherent in assessing the English proficiency and content knowledge of the diverse high school English language learner (ELL) population and offers recommendations to federal policymakers for creating reliable, valid, and accessible assessments for ELL students.

In ‘Students with Disabilities: Expectations, Academic Achievement, and the Critical Role of Inclusive Standards-Based Assessments in Improving Outcomes,’ Quenemoen (2009) describes issues concerning the assessment of high school students with disabilities in a standards-based accountability system, ways to evaluate assessments that are inclusive of all students in the accountability system, and recommendations for policymakers.

In ‘Assessments and Technology: A Powerful Combination for Improving Teaching and Learning,’ Martin, Daniel, and Ann (2009) describes how the use of technology to assess students and to record and analyze
performance can result in timely, appropriate, and individualized instruction for all students. They highlight some of the innovative approaches in using technology to assess student progress, address current challenges in the use of technology, and provide recommendations to federal policymakers to overcome those challenges.

The purpose of the paper, ‘Automating Formative and Summative Feedback for Individualised Assignments’ by Hamilton (2009), was to report on the rationale behind the use of a unique paper-based individualised accounting assignment, which automated the provision to students of immediate formative and timely summative feedback. In this approach the students worked towards completing their assignment, the package provided immediate formative feedback with sufficient indicators for the student to identify that they had made an error and provided encouragement for the student to take appropriate corrective action until they were satisfied that their answer was correct. Once the student was satisfied with their work, their submission was automatically marked by the assessment package according to the pre-set marking scheme. The assignment experience reported that the potential for interactive spreadsheets to be created for a wide range of rule-based accounting problems to provide formative and summative feedback. The package can be (and has been) easily extended beyond financial accounting to many other accounting- and non-accounting-related fields, e.g.
tax, audit, economics and statistics. In fact, individualised assignments utilising interactive spreadsheets appear to have broad applicability in any educational context (including mathematics, engineering and science) where a correct numerical answer is required.

The study, ‘Exploring the Behavioural Patterns in Project-based Learning with Online Discussion: Quantitative Content Analysis and Progressive Sequential Analysis’ by Hou (2010), explores the behavioural patterns and limitations faced by students in project-based learning where online forums are used. This study conducted an empirical case study of an online project-based learning activity in a management course, in which 70 college students participated. The study integrates two analytical approaches: quantitative content analysis and progressive sequential analysis. The analytical approaches allow researchers to explore and visualize the content and patterns of participants’ online project learning discussion behaviours. The results indicate that learners’ limitations include poor time-management and insufficient initial data collection. The students also demonstrated a lack of proper data evaluation processes and sufficient comprehensive analysis. The limitations are in-depth discussed and suggestions for teachers and educational software developers are also proposed.
Studies related to interactive and online learning environments

The World Wide Web (WWW) has become the standard information system for the world’s science education community. From e-learning to information and edutainment, the Web allows inexpensive and fast access to novel and useful services provided by individuals and institutions from all over the world. At the same time, the availability of digital records has made it much easier for researchers to quantitatively investigate various aspects of human behaviour and human activity of accessing information in the World. They provide access to abundant high-quality, free online resources for learning. Increased classroom access to the Internet enables much better use of online resources by teachers. By supporting user networks, which contribute knowledge, either actively through annotations or reviews, or passively through patterns of resource use, digital libraries also provide important data for web-usage studies. The following are some studies based on learning through online and interactive environments:

The study of Bruning (2005) under the title ‘The role of Critical thinking in the online learning environment’ indicates that critically reflective learning provides students with an opportunity to evaluate concepts learned and apply them to their experiences, contemplating its affect on future learning. This process occurs in a learning community where student interaction and feedback fuels the learning process leading to a higher level of
critical reflective thinking for the learner. The challenge for online instructors is how to incorporate critical thinking in the online environment in an effective manner. This paper addresses the issue of critical thinking and how it is applied in an actual online environment through an interactive exercise created by the instructor. The exercise not only fuels student learning but also creates a learning community in which students interact and share ideas. The exercise described in this paper incorporates critical thinking in the online environment to meet the goals of developing reflective critical thinking in students and to nurture and online learning community that can be used as a model for other online instructors.

The case study conducted by Vonderwell, Liang and Alderman (2007) under the title ‘Asynchronous discussions and assessment in online learning’ explores asynchronous online discussions, assessment processes, and the meaning students derived from their experiences in five online graduate courses at the Colleges of Education of two Midwestern higher education institutions. The findings suggest that asynchronous online discussions facilitate a multidimensional process of assessment demonstrated in the aspects of structure, self-regulatory activities, learner autonomy, learning community and student writing skills. The students valued the discussions as an essential component of their online learning. Further research is needed to
understand the characteristics of online assessment, and what assessment strategies or criteria enhance assessment and learning.

The paper entitled ‘Assessing online asynchronous discussion in online courses: An empirical study’ by Liu (2007) reported the results of a recent empirical study conducted at a large, public, Midwestern university. Fifty online courses offered by five different Masters’ programs were examined and twenty instructors were interviewed. Major research questions included: How was the online discussion organized in the courses examined? How did the instructors grade the discussion? Why did they make certain decisions on these issues, such as what their rationales, considerations, and concerns were? Online asynchronous discussion is argued to have many benefits for student learning. However, whether student participation in the asynchronous discussion should be assessed is controversial. Furthermore, how to assess their participation has been a huge challenge faced by many online instructors.

The purpose of the study ‘Assessment in online distance education: A comparison of three online programs at a University’ by Kim (2008) was to investigate whether or not the principles of assessment in online education are reflected in the assessment activities used by the developers and administrators of actual online distance courses. Three online distance education programs provided at a large mid-west university were analyzed;
the School of Continuing Studies – undergraduate distance program, the School of Business – distance MBA program, and the School of Education – distance graduate program. The results of the study showed that the assessment activities of online distance courses do not strictly follow the principles suggested in the literature.

The study of Al-Shalchi (2009) entitled ‘The effectiveness and development of online discussions’ deals with the importance of the effective design of online discussions and discusses ways that instructors can help students have effective discussions. The study allows for the students to interact with each other (Both synchronous and asynchronous online discussions) without being in a classroom. In online discussion environments, students are able to build strong ties and relationships with each other.

The meta analysis made by Means, Toyama, Murphy, Bakia and Jones (2009) in the title ‘Evaluation of evidence – based practices in online learning’ found that, on average, students in online learning conditions performed modestly better than those receiving face-to-face instruction. The difference between student outcomes for online and face-to-face classes—measured as the difference between treatment and control means, divided by the pooled standard deviation—was larger in those studies contrasting conditions that blended elements of online and face-to-face instruction with conditions taught entirely face-to-face. Analysts noted that these blended
conditions often included additional learning time and instructional elements not received by students in control conditions. This finding suggests that the positive effects associated with blended learning should not be attributed to the media, per se. An unexpected finding was the small number of rigorous published studies contrasting online and face-to-face learning conditions for K–12 students. In light of this small corpus, caution is required in generalizing to the K–12 population because the results are derived for the most part from studies in other settings (e.g., medical training, higher education).

The paper ‘Is it live or is it Internet? Experimental estimates of the effects of online instruction on student learning’ (Figlio, Rush, and Yin, 2010) presents the first experimental evidence on the effects of live versus internet media of instruction. Students in a large introductory microeconomics course at a major research university were randomly assigned to live lectures versus watching these same lectures in an internet setting, where all other factors (e.g., instruction, supplemental materials) were the same. Counter to the conclusions drawn by a recent U.S. Department of Education meta-analysis of non-experimental analyses of internet instruction in higher education, it finds modest evidence that live-only instruction dominates internet instruction. These results are particularly strong for Hispanic students, male students, and
lower-achieving students. The study also provides suggestions for future experimentation in other settings.

The purpose of the study ‘Students' Perceptions of Online Learning and Instructional Tools: A Qualitative Study of Undergraduate Students Use of Online Tools’ by Armstrong (2011), was to describe undergraduate students' experiences and perceptions of online courses based on interviews, observations, and online focus groups. It describes motivational and learner characteristics within online classes, the positive and negative aspects of online courses as experienced by students, what instructors can do to improve the teaching of online courses, and how undergraduate students' perceptions of the online learning environment and the tools used affects the selection of their approach to learning. Data analysis from this study produced five primary findings across the four research questions. The first finding was the role of communication in shaping students' perceptions and approach to learning. The second finding was that participants did not perceive the negative attributes of technology to be inherent to the technology itself but in its use and implementations. The third was that course organization is key to student learning and success. The fourth was that student approaches to learning appeared to be shaped by both the structure of the learning environment and the nature of assessments used in the online environment.
The fifth was that students use nonacademic resources to locate information rather than the university library.

A study was conducted by Nakayama and Yamamoto (2011) under the title ‘Assessing Student Transitions in an Online Learning Environment’ to evaluate online learning activities. The purpose of this study was to examine participants' assessments made during the transitional phase in an online learning environment which includes blended and fully online courses at a Japanese national university. Students were enrolled in two-unit Master's or Bachelor's degree courses which were taught by the same professor. The total number of students with valid survey data was 184. A survey questionnaire consisting of 10 questions measured the self-assessments of students' online learning experiences. Three factors were extracted. There were no significant differences in all factor scores between the beginnings and the ends of the courses. These results show the coherence of students’ assessments during the course.

This paper ‘Understanding Cognitive Presence in an Online and Blended Community of Inquiry: Assessing Outcomes and Processes for Deep Approaches to Learning’ by Akyol and Garrison (2011), focuses on deep and meaningful learning approaches and outcomes associated with online and blended communities of inquiry. Applying mixed methodology for the research design, the study used transcript analysis, learning outcomes,
perceived learning, satisfaction, and interviews to assess learning processes and outcomes. The findings for learning processes and outcomes indicated that students in both online and blended courses were able to reach high levels of cognitive presence and learning outcomes. The results suggest that cognitive presence in a community of inquiry was associated with perceived and actual learning outcomes. The study recommended that future research efforts may focus on quantitative measures to establish links between cognitive presence and the quality of learning outcomes.

The study ‘Student Interaction with Online Course Content: Build It and They Might Come’ by Murray, Perez, Geist and Hedrick (2012), investigated student patterns of access to instructional resources provided in an asynchronous online digital literacy course offered at a regional university in the United States. Frequency counts and access rates collected from a learning management system were used to assess patterns of student retrieval of course materials in four categories: core materials, direct support, indirect support and ancillary materials. Results were consistent with student survey responses and indicated that students selectively access course content based upon the degree to which they perceive it will positively influence performance and outcomes on assignments and assessments.
A quote from the study, ‘Interactive Learning Online at Public Universities: Evidence from Randomized Trials’ (Bowen, Chingos, Lack & Nygren, 2012), explains, “By ‘ILO’ we refer to highly sophisticated, interactive online courses in which machine guided instruction can substitute for some (though not usually all) traditional, face-to-face instruction. Course systems of this type take advantage of data collected from large numbers of students in order to offer each student customized instruction, as well as allow instructors to track students’ progress in detail so that they can provide their students with more targeted and effective guidance.” As long as the courses are student-centered, professors still hold authority and are responsible for guiding and interacting with students, there are reasons to be cautiously optimistic about these learning systems, which can potentially demonstrate tangible improvement over large lecture-based introductory courses in learner–teacher and learner–learner interaction.

In ‘Interactive Learning Online at Public Universities: Evidence from a Six-Campus Randomized Trials,’ Bowen, Chingos, Lack and Nygren (2012) measure the effect on learning outcomes of a prototypical interactive learning online (ILO) statistics course by randomly assigning students on six public university campuses to take the course in a hybrid format (with machine-guided instruction accompanied by one hour of face-to-face instruction each week) or a traditional format (as it is usually offered by their campus,
typically with 3–4 hours of face-to-face instruction each week). They find that learning outcomes are essentially the same—that students in the hybrid format "pay no price" for this mode of instruction in terms of pass rates, final exam scores, and performance on a standardized assessment of statistical literacy. These zero-difference coefficients are precisely estimated. They also conduct speculative cost simulations and find that adopting hybrid models of instruction in large introductory courses have the potential to significantly reduce instructor compensation costs in the long run.

The paper ‘Wikifolios and Participatory Assessment for Engagement, Understanding, and Achievement in Online Courses’ by Hickey and Rehak (2013), presents new insights from ongoing design-based research of graduate-level online courses in a school of education. This research refined the use of widely available wikis and online assessment tools to deliver broad learning outcomes. The research started with a general goal that reflects current situative theories of instruction and assessment, and resulted in five general design principles and course features used to enact those principles. Reflecting the first two principles, each student articulated the relative relevance of chapter concepts for a personally meaningful problem context and then engaged threaded discussions within and across networking groups via comments placed directly on wikifolios. Reflecting the third principle, wikifolios and comments were not directly graded; rather, they were
evaluated using student reflections placed directly in their wikifolio. Reflecting the fourth and fifth principles, conceptual understanding and aggregated achievement were discreetly assessed with timed exams using conventional items.

The purpose of the study ‘The Use of Online Modules and the Effect on Student Outcomes in a High School Chemistry Class’ by Lamb and Annetta (2013) was to review the efficacy of online chemistry simulations in a high school chemistry class and provide discussion of the factors that may affect student learning. The sample consisted of 351 high school students exposed to online simulations. Researchers administered a pretest, intermediate test and posttest to measure chemistry content knowledge acquired during the use of online chemistry laboratory simulations. The authors also analyzed student journal entries as an attitudinal measure of chemistry during the simulation experience. The four analyses conducted were Repeated Time Measures Analysis of Variance, a three-way Analysis of Variance, Logistic Regression and Multiple Analysis of Variance. Each of these analyses provides for a slightly different aspect of factors regarding student attitudes and outcomes. Results indicated that there was a statistically significant main effect across grouping type. Analysis of student journal entries suggested that attitudinal factors may affect student outcomes concerning the use of online supplemental instruction. Implications for this
study showed that the use of online simulations promotes increased understanding of chemistry content through open-ended and interactive questioning.

The paper ‘Using a Design-Based Research Study to Identify Principles for Training Instructors to Teach Online’ by Shattuck and Anderson (2013), evaluated an online training course for online instructors. This intervention was designed as a possible solution to the problem facing some higher education institutions of how to provide quality, accessible training for mostly part-time instructors who were making the transition to teaching online. The research project explored whether the training course had any impact on the participants' later teaching practice. The major outcome of this research study was the identification of design principles that was used by other researchers and practitioners designing online instructor training.

All these studies reveal that well-designed online courses can be effective. The studies advocate so called Interactive Learning Online, which can provide instant feedback and dynamically adapt the course to individual student’s needs.
Conclusion

The investigator does not claim that the survey of the studies reported in this chapter is complete. But it is hoped that the general trend in the studies can be considered as conclusive.

At the initial stage, at the time of theoretical review, the investigator aimed to develop a complete web based software solution to achieve web based interactive learning. Thus, the framework and components for the development of the web based software are identified. And the psychological principles and learning theories related to online learning were also recognised.

In the second stage, the investigator reviewed different learning management systems and supporting software systems available in the field. The major software systems reviewed are mentioned in the software review part. Based on the software review, the investigator decided to customise the learning management system - MOODLE.

In the third stage, a thorough review is conducted on related studies. The broad area is classified into specific areas of studies on the use of computers in education and studies related to interactive and online learning environments. The analysis of these studies helped the investigator a lot in developing a web based learning management system for the state of Kerala.
A critical appraisal of all the reported studies clearly indicates that studies pertaining to MOODLE based instruction scanty in number, that too in the Indian context. Studies reported from Kerala scenario are very seldom. This fact supports the attempt of the researcher in undertaking the problem – a very rarely attempted problem from Kerala background, which signifies the novelty of the problem at hand, where by the researcher is adequately been rewarded for his project.