CHAPTER 2

LITERATURE SURVEY

2.1 INTRODUCTION

Significant works on Information and Communication Technology (ICT) based instructional material design, development and their issues have been reported in various published literature. The areas range from e-learning technologies, pedagogical aspects, perception studies, and issues. The issues are related to specific instructional strategies for ICT based instruction, learner characteristics and causes of failures in e-learning etc. The components relevant to identification of research problem for this research work are reported in this chapter. The literature study is broadly divided into three categories namely i. Web based learning; and ii. Instructional methodologies and iii. Instructional strategies for Information and Communication Technology (ICT) based instructions.

2.2 ON WEB BASED LEARNING

According to Said Hadjerrrouit (2006), “Web-based learning must take into consideration that education has triggered a shift from the teaching paradigm to the learning paradigm. Besides the evolution of the learning paradigm, educational technologies are evolving constantly. Clearly, Web-based learning systems must constantly evolve in order to meet their requirements. However, still much of the development of Web-based learning is carried out without a true understanding of requirements that are proper to Web-based learning, resulting in bad analysis and design, poor quality, and maintainability. The author has proposed a framework for Web-based Learning. He has pinpointed to six external components that influence Web-based Learning. They are: ‘Learners’; ‘Usability Issues’, ‘Course Content’;
‘Legal & Ethical issues’; ‘Pedagogy / Learning Theories’; and ‘Information Technology’. The author has suggested certain issues that must be considered while designing the framework. The author has indicated the issues for these six components:

**Learners - Issues:** Learning styles, prerequisite knowledge;

**Usability issues:** User-centered design, look and feel, ease-of-use and ease-of-learning;

**Course content – Issues:** Subject information, topics, subtopics;

**Legal & ethical issues:** Legal & ethical conventions, copyright protection, security against knowledge manipulation;

**Pedagogy / learning theories – Issues:** Behaviorism, cognitive constructivism, social constructivism;

**Information Technology – Issues:** Internet Web, Web Authoring Tools, Java, Web databases, LMS, etc.;

The author has concluded that ‘Developing Web-based learning is a complex matter. Web-based learning has a number of components and subcomponents, which include both technical and non-technical aspects. There are methodologies, but few that provide a sufficient framework for developing Web-based learning. The methodology presented by the author aims to provide such a framework. It attempts to provide pedagogical and methodological foundation as prerequisite for effective implementation of Web-based learning’. However learning through web or through distance education mode heavily depends upon the psychology of learner characteristics (Ananda Kumar K.P. and Shanthi S. 2005 and Barron, T. 2002).

The same author Said Hadjerrouit (2005) has stressed in another context that, “One of the main reasons for the low acceptance of Web-based applications is the large gap between design models and the implementation model of the Web. The pedagogical model will be further developed through continuous cycles of design,
experimentations, evaluations, and research directions, in particular: 1. Explore further the potentialities of constructivism in order to refine the understanding of learning issues; 2. Improve the evaluation methods, data collection and analysis, and develop hypotheses, theories or “proto-theories” that help communicate relevant educational and didactical implications to information technology educators and practitioners. Designing a Pedagogical Model for Web Engineering Education, 3. Refine the learning activities of the Web engineering construction process and develop pedagogical patterns for analysis and design activities that may be reused to solve new, but similar Web engineering problems. 4. Improve teamwork, communication, and collaboration in order for the pedagogical model to be more effective”.

According to Bouchaib Bahli and Dany Di Tullio (2003), Web Engineering continues to grow in popularity with practitioners and academics alike, and so far there has not been any assessment of its accumulated body of knowledge in terms of academic research. Since Web Engineering was established not long ago, it is perhaps time to take stock of the efforts made in this field. The authors suggest through their elaborate state-of-art literature survey, stress for a significant need for theory-based research in Web Engineering. As pointed out in the work of Murugesan et al. (1999), as Web-based systems and applications evolved rapidly, the complexity of designing, developing, managing, and maintaining these systems also expanded. Reflecting the significant growth of Web development, steady streams of research surfaced about various stages of the Web development process, from planning, analysis, to engineering, testing, and evaluation of Web-based systems (Deborah R. Campeau 2002). Furthermore, academics recently argued for the establishment of Web Engineering as a discipline in its own right to address the growing need for disciplined approaches and new methods and tools for the development, deployment, and evaluation of Web-based systems. According to Murugesan et al. (1999), ‘Web Engineering is the establishment and use of sound scientific, engineering, and management principles and disciplined and systematic approaches to the successful development, deployment and maintenance of high quality Web-based systems and applications’. According to the survey, out of
25 papers surveyed, only 2 deal with content design of e-resources. Content design forms an important part of Web Engineering, that is, a pre-requisite to production. These are parallel with ‘Architectural Design’, ‘Navigation Design’ and ‘Interface Design’, according to the authors. Yet again, the authors have demonstrated that the research methodology that can be adapted for Web Engineering dealing with content design would be: Design Research and Case study.

Two important considerations are needed for implementing Web-based learning applications according to Chang S. Nam and Tonya L. Smith-Jackson (2007): (1) integration of the user interface design with instructional design and (2) development of the evaluation framework to improve the overall quality of Web-based learning support environments. Their study also confirmed that for an e-learning environment to be successful, various aspects of the learning environment should be considered such as application domain knowledge, conceptual learning theory, instructional design, user interface design, and evaluation about the overall quality of the learning environment.

The nature of the relationship between faculty integration of technology into classroom instruction and students’ perceptions of the effect of computer technology to improve their learning, has been extensively studied and reported by Jared Keengwe (2007). According to this author, faculty may assume that students learning in modern technology era are highly competent in general computer skills and are more prepared to learn with technology as opposed to the previous generations of students. Evidence from the author’s study provides a data set to question such thinking. Instead, there is evidence suggesting a need for direct instruction in the use of sophisticated software programs. Further, the distinction between personal and course-related use illustrates the need for faculty to create bridges between personal and instructional use of technology for improved student learning. Quality education needs to be looked at from multiple perspectives. The first is to ensure that the education offered results in the quality of learning imparted, not mere rote learning as it is often reduced to, in today's education (Srivathsan K.R. 2003). This is possible if we respect the following objectives while imparting the training, say through e-mode.
On logical sequencing of learning objects, Terence C. Ahern and Nancy Van Cleave (2002) have stated that “We currently have unprecedented access to information and resources, yet with all the advances in technology and profession of Web sites, there is no standard on how to transform this deluge of content into instruction using technology. Specifically, there is a lack of direction on how to effectively sequence individual learning objects (reusable digital resources) that makes sound instruction sense. The authors have presented an XML based meta-grammar to categorize learning objects into meaningful human terms and for lesson sequencing. A flexible interactive user selectable object sequencing using graphical user interface has been developed and demonstrated by the authors.

An important observation by Natasha Boskic (2003), “Technical/operational aspect of learning objects reusability deals with the problems of cataloging, retrieving learning objects and creating a system for repository interrelation. Some researchers think that resolving the instructional/pedagogical issues is where real challenges lie.”

According to Jonassen (1999), technology in learning can be seen as ‘Technology is more than hardware. Cognitive learning strategies, critical thinking skills and replicable, applicable techniques can be engaged with the learner via using technology’.

“Systems and environments to support e-Learning require detailed specification of learning needs materials, activities and delivery methods and needs. The complexities of integration of the different ICT components according to these learning needs and sound pedagogical approaches, demand frameworks not too dissimilar to information systems design and development methodologies. These have been traditionally split Instructional Design (ID) methodologies. However, the term “Instructional” has strong connotations with the behaviourist school of thought and could indicate a focus on teaching centered approach rather than a less objectivist learner-centered view of education”, according to Baptista Nunes J. M. and Sue Morón-García (2002).
According to the findings of Uden L. and A. Alderson (2000), application of Instructional Design Theories and the Instructional System Design processes offers many benefits to helping students in their learning. It enables students to classify the subject into learning outcomes using a taxonomy. The Instructional System Design processes help students to identify the activities involved in learning the subject. Finally, they also help students to assess their learning with the appropriate learning outcomes.

According to Siew-Woei Ling et al. (2008), “A good instructional design model would be one that acknowledges the relationship among learners, instructors, learning materials and learning environment.”

The design of problem solving instruction will vary depending on how well defined the problem is (Martha Pimienta Giraldo and Alfonso Melendez Acuna 2005). Problem solving lessons can be introduced through five principles:

- **Deploy attention**: Presenting an interesting and challenging problem that the learners will learn to solve can gain attention and begin to identify the purpose of the instruction.

- **Establish instructional purpose**: The instructor may describe the nature of problems that the students will learn to solve.

- **Promote interest and motivation**: Suggesting how problem solving in this domain may assist learners in everyday problems that can promote interest. Problem solving can be motivated in itself. The instruction should be constructed to provide successful practice as quickly as possible.

- **Preview lesson**: The instruction should inform the learners that they will be going through a succession of problems with increasing complexity. The instruction may preview the primary strategies that will be employed and the learners responsibilities within the strategies.
2.3 ON INSTRUCTIONAL EFFECTIVENESS OF E-CONTENT

Instructional objectives in many learning tasks are not just a few, but more than thirty according to Y. Akpinar et al. (2004). Considering to prepare one learning object for each learning objective and to aggregate certain number of learning objects for a learning task may be a complex task for some. Therefore, in addition to be able to facilitate creating learning objects for individual learning objectives, the authors study has further explored that an Learning Content Management Systems (LCMS) with facilities to construct large in size and SCORM compliant learning objects may help online material developers. Effectiveness of the target system should be evaluated both at development stage and usage stage with lectures and material consumers, online learners.

According to Ian Douglas (2001), “There is currently a lot of interest in the concept of learning objects. Learning objects are discrete units of learning resources based on agreed standards. The idea behind learning objects is to promote greater reuse of old resources within new instructional systems development. The main work in learning objects has primarily focused on defining the technical requirements and standards for computer based learning objects. The technology itself is not likely to bring the benefits promised by reusable objects without a change in method & used by practicing instructional designers. The instructional design implications of the learning object approach is examined to determine the adaptation required in instructional design methodologies. Object-oriented software engineering is proposed as a useful basis for new thinking in instructional design methodology”.

As per Hwee-Reei Chong and Chien-Sing Lee (2006), “An evolutionary perspective of course design and development requires capturing, managing and reusing pedagogical knowledge in various contexts. They address the capture, management and reuse of two aspects of pedagogical knowledge in our OntoID authoring tool: instructional design knowledge and knowledge embedded in learning objects. Management and reuse are made possible through the use of software design patterns. Significance of the study lies in the Eclectic Instructional Design
Builder pattern, which bridges the gap between behaviourist, cognitivist and constructivist learning approaches; the case-based pattern which forms the basis for our case-based knowledge base, case-based search and modification of learning strategies and tasks to suit different contextual needs; and the Unified Content Model pattern which enables dynamic retrieval and assembly of parts of learning objects”.

According to Maia Dimitrova et al. (2004), “Flexible pedagogical frameworks are needed to underpin e-learning environments in order to ensure that they address effectively the individual learning approaches of an increasingly diverse student population”. As per the authors, “one pedagogical framework for instructional design, has identified its limitation in supporting two types of learners: those who rely extensively on social interaction and those most in need of learning support in the novel mode of learning. To support the learning processes of such students, they should be given a choice of learning activities and tasks that support the development of different cognitive skills and promote meaningful online communication”.

According to Chickering and Gamson (1987), students of traditional class rooms must do more than just listening to what is said in class, such as read, write, discuss, or be engaged in solving problems constructively. The trainees of ICT based instructions take ownership of their learning (Meyen et al. 1999). Given the varied forms of learning styles, unavailability of ICT based technologies and skills, a blended approach is often adopted where as blending the above two, will bring out a variety of tools that may be used for stimulating and maximizing the learners’ learning potential (Dean et al. 2001).

ICT based learning should be personalized in its instructional environment (Graven and Mac Kinnon 2005). Personalized learning is a learning approach that facilitates and supports individualized learning. Each learner has a learning path that caters to the particular learner’s learning needs and interests in a productive and meaningful way. One of the attributes of personalized learning is the ability to dictate learners’ learning. For instance, learning objects can be used to
facilitate personalized learning if integrated with systems that can present different learning objects to different learners simultaneously (Graven and MacKinnon 2005).

Robert Biddle et al. (2001) have suggested that connection between learning and design is more important for two different reasons. The first is that design is difficult, and learning how to design is itself an important issue. The second is that design itself is an activity with important similarities to learning. Design involves learning about the domain, and about requirements. Many important design techniques involve attempting solutions through the use of heuristics, evaluation of the result and iteration to improve. The importance of instructional design for better learning of Computer Science and Engineering subjects has been stressed. Assiter K.V. (2005) also suggests that students entering from computer science stream are familiar with a non-sequential, dynamic problem solving style (where they receive immediate feedback about solution correctness), and this conflicts with the learning requirements of Analysis. This could be addressed by supplementing traditional instruction in analysis with tools that make the process similar to problem solving. This is an important finding that stresses the need for guided practices for problem solving in Computer Science and Engineering subjects.

Lister R. and Leaney J. (2003) opine that emphasis on reading leads to a clearer and less discursive lecturing style, where we simply read though and discuss complete class definitions. This is more truer in Computer Science and Engineering contents (David J.Lilja (2001).

According to Cross et al. (2007), multimedia communities and virtual worlds provide a learning environment that stimulates learners’ high order thinking and knowledge development and creates social groups. Learning objects as defined by Wiley D. A (2000) are digital resources that can be re used to support learning. A learning object is an entity, digital or non-digital that can be used, re used, or referenced during technology supported learning. Learning objects are created to provide useable content in various disciplines and context, as a result of cutting down on production time and cost, enhancing productivity, and improving the
quality of learning (Koohang 2004). The learning object’s potential of being re used, adapted, and scaled has led to their wide usage within ICT based learning (Hodgins 2000).

Graven and MacKinnon (2005) affirm that the current ICT trend should place emphasis on creating pedagogical technologies to support the authoring of learning objects.

Capretz and Lee (1993) state that the basic programming constructs and their semantics should be introduced by using environment model of evaluation bearing in mind the needs of the ICT industry. This helps the student to assess the fundamental requirement of study on course objectives in subjects related to ICT industries, is more important.

Hansson (2006) pointed out that the adoption of technologies in education has created new opportunities for interaction in the teaching learning activities. For example, Garrison et al. (2000) through their community of inquiry model assert that the true uniqueness of ICT based learning lies in its multidimensional forms of multiplicative communication and interaction. Through these interactions, learners will be able to assume control and directly influence their learning outcomes.

Salmon’s Five Step Model (Salmon 2000) reflects a positive progression in the quality and intensity of interaction between trainees-trainees and trainees-trainer. This model advises on the instructor’s role during learning depending on the learners’ needs and circumstances in a learner-centered atmosphere.

The Content-Communication-Collaboration Model (Dempster 2004) provides selection of technologies and methods that support increased integration of dialogue across the learning activities. This model allows mapping of learning activities (presentation, practice, communication, interaction and collaboration) during learning.
The Conversational framework (Laurillard 1993) model constitutes an iterative dialogue between trainer and trainees that facilitates high-level cognitive skills.

Omwenga and Rodrigues (2006) also advocate the use of technology mediated learning models to aid learning in a flexible environment. They provide a framework for evaluating and validating any ICT based learning processes in an integrated environment, taking into consideration the contextual and pedagogical issues. These initiatives present an understanding of the importance of building communities and interaction within ICT based learning environments that facilitate learning.

Firedman and Deek 2003 – Wickipedia 2008 have stated that, with the expansion of industrial technologies throughout all sectors of the education community, research into the appropriateness, effectiveness and modalities of learning via ICT continues to grow. This report has very clearly indicated the requirements of Institutional education or in particular the instructional designs in learning computer subjects, as it forms basic requirements for ICT industries. Instructional designs invariably try to adopt any specific instructional theory. Instructional theories lead to formation of instructional models – blue prints for designing Instructions (Sein K. et al. 1998),

Patsula J.P (1999) has elaborated and presented practical applications of learning theories for ICT based instructions. According to him, Gagne’s ‘Conditions of Learning Theory’ identifies four major types of learning, viz., Verbal, Intellectual, Cognitive and Motor skills. This theory emphasizes learning hierarchy for sequencing the instructions (Kearsley, 1994). This is an important issue as for as ICT based instructions are concerned.

Bruner’s ‘Constructivist Theory’ (as cited by Kearsley 1994) allows the individual learner to go beyond the information given. According to Bruner, the instructor should try and encourage learners to construct hypotheses, makes decisions, and discover principles by themselves. This theory addresses on the
effective sequencing through which to present material. This is very important in the design of instructions for ICT based learning. The theory insists that the instructions should be concerned with the experience and context that induce the learners to learn. This aspect is more explicitly specified by Merrill (2002). However, Merrill cautions against the overuse of attention-getting strategies, especially on the computer (Patsula J.P 1999). According to this theory, ‘by sequencing screens and presenting related material together will improve retention’.

It is stated that the theory which is most applicable to computers and online instruction is Carroll’s Minimalist Theory (Carroll 1998) according to Patsula J.P (1999). The theory suggests that:

- All learning activities should be meaningful and self-contained.
- Activities should exploit the learner’s prior experience and knowledge.
- Learners should be given realistic projects as quickly as possible.
- Instruction should permit self-directed reasoning and improvising.
- Training materials and activities should provide for error recognition and use errors as learning opportunities.
- There should be a close linkage between training and the actual system because “new users are always learning computer methods in the context of specific pre-existing goals and expectations”.

It may be noted that theory although specifies many explicit entities for ICT based learning instructions, the instructional sequencing is not explicitly specified unlike Merrill’s model (discussed later). Carroll (Patsula J.P 1999) advises that learners should be allowed to start right away on meaningful tasks.

One of the basic requirements of the present research work is to finding out the presence of instructional objectives in course modules of middleware
training programs (of Industries). The literature reviewed and presented below emphasizes the importance of taxonomies or cognitive structures to specify instructional objectives. They are elaborated in what follows.

Instructional designers have long recognized the importance of analyzing subject matter for the purpose of facilitating learning, via appropriate knowledge selection, organization and sequencing. Bloom and his associates (Bloom B.S. 1965, Krathwohl D.R., et al. 1973) have introduced a set of categories, which are widely used for subject content analyses as seen from various research works presented. However, the recently popularized ‘First Principles of Instruction’ has many advantages for problem centric courses like Engineering and Technology, Computer Science and Applications, etc., which is substantiated through various literature study.

Gagne Robert M. (1985) has proposed taxonomy of learning objectives that also found wide acceptance in the instructional design community. For each of his categories, Gagne proposed unique conditions for learning, based on Information Processing Theory i.e. for an input there is a process and an output. Gagne has identified mental conditions for learning. Different types of knowledge and skill require different conditions for learning and retention. Gagne further identifies three events of instruction: i) stimulating to gain attention ii) informing learner of the objectives of the instruction iii) reminding learners of relevant previously learnt materials. This corresponds to the different activation phases, where new knowledge builds on the learner’s existing knowledge. Learners recall or apply knowledge from relevant past experience as a foundation for new knowledge. This could be previously learnt courses or job experiences.

David Merrill has elaborated and extended Gagne’s categories in his work on Component Display Theory (Merrill M.D. 1994). As Gagne’s model, Merrill’s Component Display Theory is based on Information Processing Theory and therefore it depicts reclaiming nature. A general Educational model of David Merrill is presented and explained in Chapter III. His theory is further elaborated. Merrill’s approach of putting a real-life problem into the centre of the instructional
episode is particularly suited to any problem-based learning approach (Nordhoff Helga I. 2002). As almost the entire ICT education is problem-based, Merrill’s theory is best suited for it (Merrill M.D. 2002), and it would be more so, as Merrill’s model is an offshoot from Gagne’s, which was derived from Information Processing Theory. In Merrill’s design theory (Merrill M.D. 2002), the ‘First Principles of Instruction’ (FPI), emphasize the following aspects: the value of using the real-life problems in the instructional event; the importance of activation of existing knowledge of the learner; the role of demonstration; guided problem solving and the integration of new knowledge with existing knowledge.

Instructional strategy is changing along with emerging technology. As per the observation of Reigeluth C.M. (1999), “Education and training worldwide is changing from standardization to customization; from educator-centered or teacher-centered to learner-centered, from memorization to understanding. Learners are expected to direct their own learning, pace their learning activities and to become lifelong learners. Companies need employees who can take initiative, think critically and solve problems”. He further debates: “This requires a paradigm shift in education and instruction. Educators become facilitators and only one of many resources available to learners. It also implies that educators have to change their method of instruction. A multitude of instructional design theories are being developed to assist educators in their new roles”. Reigeluth dwells on various education theories as: “Learning-focused instructional design theory must offer guidelines for the design of learning environments that provide appropriate combinations of challenge and guidance, empowerment and support, self-direction and structure”. These different theories are elaborated by Nordhoff Helga I. Nordhoff Helga I. (2002) has lucidly presented the different theories. Instructional design theory takes into account the findings of both learning theories and curriculum theory. These three theories in turn influence the actual design process. In view of the close relationship between instructional design theory, learning theory, curriculum theory and the design process, instructional designers should be familiar with all four theories.
Learning Theories constitute one aspect of cognitive psychology; they describe how learning takes place. Reigeluth further postulates, “Three views of learning have emerged during the past 100 years of research on learning: learning as response strengthening, learning as knowledge acquisition and learning as knowledge construction”.

Goold A. and Rimmer R. (2000) have also observed that different learning styles excel for different tasks within a discipline or even within a single course. This implies that success in computer science is not limited to students with specific combinations of learning styles.

Curriculum theories are concerned with the content of instruction, i.e. with ‘what to teach’. Content is closely linked to the goal of the instruction, with defined outcomes to be achieved and identified skills to be mastered. The Curriculum theory explores areas such as the social construction of knowledge, the influence of technology on learning and the effect of politics on curricula. It examines ideological orientations towards the curriculum and provides guidelines for curriculum design and development. The Curriculum theory implies interaction with and influences on a range of factors. Comparative studies in different distance learning including technology enabled media and methods have been reported (Dean P. et al. 2001)

Schubert W.H. (1986) has further remarked, “The character of curriculum shapes and is shaped by its external relationships with knowledge, perspectives and practices in other educational domains: administration, supervision, foundations, policy studies, evaluation, research methodology, subject areas, educational levels, teaching or instruction, special education, education psychology and so on”. The centrally adapted and customized instruction is clear from Reigeluth’s statement:

“An Instructional Design Theory is a theory that offers explicit guidance on how to better help people learn and develop. The kinds of learning and
development may include cognitive, emotional, social, physical and spiritual learning”.

Instructional design theories are goal-oriented and must identify methods of instruction for specific situations. These methods have sets of components, which make them flexible and adaptable, as noted by Gros B (1997): “Instructional design models have the ambition to provide a link between learning theories and the practice of building instructional systems”. Some instructional design theories are: Cognitive Education, Multiple Approaches to understanding, Teaching and Learning for Understanding, Open Learning Environments, Constructivist Learning, Learning By Doing, Collaborative Problem Solving, Problem-Based Learning (PBL) and First Principles of Instruction (popularized later by Merrill). The instruction centered theories are elaborated by many researches. Saettler P. (1979) states that “one of the most significant advances in Educational technology in recent years has been the development of systems Approaches to instruction”. He believes that the concern for the entire instructional system clearly distinguishes educational technology from traditional instructional approaches.

Although Instructional Systems Design has its roots in behavioural science, it is also much concerned with the cognitive learning theory. Schiffman S.S. (1986) also describes instructional systems design ‘to be a synthesis of theory and research related to (a) how humans perceive and give meaning to the stimuli in their environment, (b) the nature of information and how it is composed and transmitted, [and] c) the concept of systems and the interrelationships among factors promoting or deterring efficient and effective accomplishment of the desired outcomes’.

The difference between unidirectional and cyclic (reclaiming) instruction theories has been brought out. According to Sue Fostaty Young (2008), Bloom’s model is hierarchical but unidirectional (explicit) and not recursive (cyclic). This is a limitation of Bloom’s model.

Jonassen’s (1999) constructivist learning approach emphasizes problem solving and includes all four phases of the First Principles of Instruction (elaborated
later in Chapter 3). The primary emphasis of his approach is problem solving as reflected by the following statements. "The goal of the learner is to interpret and solve the problem or complete the project … the problem drives the learning … Students learn domain content in order to solve the problem, rather than solving the problem as an application of learning. You must provide interesting, relevant, and engaging problems to solve. The problem should not be overly circumscribed. Rather, it should be ill defined or ill structured deliberately, so that some aspects of the problem are emergent and definable by the learners". He further recommends problem progression, namely, "Start the learners with the tasks they know how to perform and gradually add task difficulty until they are unable to perform alone". Some attention is directed toward activation. "What novice learners lack most are experiences. Related cases (demonstrations) can scaffold (or supplant) memory by providing representations of experiences that learners have not had". Demonstration is stressed, "Carefully demonstrate each of the activities involved in a performance by a skilled (but not an expert) performer. Modeling provides learners with an example of the desired performance. Two types of modeling exist: Behavioural modeling demonstrates how to perform the activities identified and cognitive modeling articulates the reasoning that learners should use while engaged in the activities. A widely recognized method for modeling problem solving is worked examples". Application is also stressed with an emphasis on coaching and scaffolding"… in order to learn, learners will attempt to perform like the model, first through crude imitation, advancing through articulating and habituating performance, to the creation of skilled, original performances. At each of these stages the learner will likely improve with coaching. The most important role of the coach is to monitor, analyze, and regulate the learners' development of important skills". He also suggests three separate approaches to scaffolding of learning: adjust the difficulty of the task to accommodate the learner, restructure the task to supplant a lack of prior knowledge, or provide alternative assessments". The reflection aspect of integration is suggested as one role of coaching; a good coach provokes learners to reflect on (monitor and analyze) their performance".
Almerico and Baker (2005) have stated in their research report, ‘when planning to teach, many educators often focus on the selection of content, teaching method, and instructional materials. The variety of components stress the need for clear objectives in lower education play an important role to lead learners to go in for higher education. Hulls C. C. W, (2005) claim that educators training students often refer to Bloom’s Taxonomy during each aspect of the instructional cycle, from planning to assessing instruction. In due course, this helps to build a strong foundation of the knowledge and its parameters in reaching the higher education objectives. When educational taxonomies are recommended for higher learning, as suggested by this research finding, the same techniques may be adapted for the higher learning environment also. Jui-Hung and Chien-Pen (2005) state that educational taxonomy gives educators a precise and common language for articulating the intended outcomes of their teaching in terms of learning activity. It is also found that the taxonomy would be valuable to today’s teachers because it provides a comprehensible list of possible learning outcomes with action verbs those operationally learning targets, towards higher education.

According to Keefe J. W (1981), learning styles are “characteristic of cognitive, affective and psychomotor behaviours that serve as relatively stable indicators of how learners perceive, interact with and respond to the learning environment from lower to higher levels of education. Felder R. M, (1996) on the other hand points out that “most engineering education has been heavily biased towards intuitive, verbal, deductive, reflective and sequential learners” while “relatively few engineering students fall into all of these five categories”. The objective, then, of any curriculum should be to teach to the “full spectrum of learning styles”. Kimmel (2003) argues that by combining techniques, tools, methods and models (i.e., the Minute Paper tool and the Constructive Learning model) we can reach all levels of Bloom’s Taxonomy of learning and accommodate all learner types.

Bruegge and Dutoit (2004) say that, “Programming can be an active or a reflective process depending on the preferred working style of the learner. Active learners might develop applications through repeated cycles of planning,
implementation and testing. Extreme programming is an example of teaching geared towards the active learner. In contrast, the reflective learner might design and model a complete solution on paper before they implement it on the computer”. Chamillard A. T. and Karolick D. (1999) have studied on how students and faculty of an introductory course use learning style, which results in improved study habits and instruction techniques, respectively. This is in agreement with Felder and Spurlin (1988) who suggested that learning style results be used to:

- Help instructors design instruction that addresses the learning needs of all computer science students, including higher learning environment, such as training.
- Give students insight into their learning strengths and weaknesses. In other words, learning style results should not be used to prevent students with non-dominant learning styles from entering the discipline.

The above research findings clearly demonstrate that the four phases or cognitive structures or portrayals of any instructional component: let it be Instructional materials, media, class room teaching/training process etc., must be quantified and researched upon (in all the components of the curriculum, particularly in the Instructional materials designed and meant for specific purposes).

2.4 SUMMARY AND FORMULATION OF RESEARCH PROBLEM

Literatures indicate that ICT based education, particularly e-learning, is emerging as an important source of education and training. Literatures clearly indicate the need for instructional models for e-content delivery. Literature points out to the need for reusable independent entities of contents that require special instructional strategies. Therefore research is demanded into trying out for new approaches through instructional models.

Reusability of these entities (literature calls it ‘objects’) is an important component in any proposal of instructional models. However, these models should
cater to local needs, thus demanding for research and development. Therefore, an innovative instructional model with these components may be tried out.

The most important findings as reported in literature have been grouped and summarized for the purpose of formulating the research problem is presented in Table 2.1.

**Table 2.1 Findings from literature that has led to identification of research problem**

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Literature support for problem formulation</th>
<th>Author(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Web based education requires a shift from teacher centric to learner centric instructional approach. Gap between design models and the implementation model of Web based instructions should be minimal.</td>
<td>Said Hadjerrouit (2006)</td>
</tr>
<tr>
<td>2</td>
<td>There is no standard for transformation of the huge deluge of subject contents into instruction using technology (in media like Web). XML based meta-grammar to categorize learning objects into meaningful human terms and for lesson sequencing have been suggested.</td>
<td>Terence C. Ahern and Nancy Van Cleave (2002)</td>
</tr>
<tr>
<td>3</td>
<td>The Technical/operational aspect of learning objects reusability deals with the problems of cataloging, retrieving learning objects and creating a system for repository interrelation. Some researchers think that resolving the instructional/pedagogical issues is where real challenges lie.</td>
<td>Natasha Boskic (2003)</td>
</tr>
<tr>
<td>4</td>
<td>An evolutionary perspective of course design and development requires capturing, managing and reusing pedagogical knowledge in various contexts.</td>
<td>Hwee-Reei Chong, Chien-Sing Lee (2006)</td>
</tr>
<tr>
<td>5</td>
<td>Merrill’s approach of putting a real-life problem into the centre of the instructional episode is particularly suited to any problem-based learning approach. As almost the entire ICT education is problem-based, Merrill’s theory is best suited for it, and it would be more so, as Merrill’s model is an off shoot from Gagne’s, which was derived from Information Processing Theory. In Merrill’s design theory, the ‘First Principles of Instruction’, emphasizes the following aspects: the value of using the real-life problems in the instructional event; the importance of activation of existing knowledge of the learner; the role of demonstration; guided problem solving and the integration of new knowledge with existing knowledge.</td>
<td>Nordhoff Helga I. (2002); Merrill M.D. (2002).</td>
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Research evidences as seen from these elaborate literature study show that most of the research objectives and research questions stated in Chapter 1 have been vindicated. Table 2.1 that has consolidated important issues and the edifice that have been extracted has supported this. From these analyses and appraisal of the literature surveyed, this research topic namely “Technical Feasibility Akin To Economic Viability For e-Content Development on Operating Systems” has emerged.

The next chapter deals with the methodology and on various tools adapted for this research work.