2. Literature Survey

Computer Aided Language Learning (CALL) as a research field has received considerable attention over the past few years. From the early days of computing, people have been talking about using computer technology to enhance teaching learning process. This has brought Computer Based Tutoring (CBT) systems into existence. A computer is used as a standalone device here. There is no use of internet or any communication tool. Student buys a diskette containing tutoring material on subjects to master it on one’s own PC. The idea of using CBT to learn a subject failed due to the absence of effective teaching strategies. CBTs were mere page-turners, and largely disappeared from the market without leaving any significant impact in the field of education [Rosenberg, 2001]. This gave rise to more sophisticated model of using computers to teach, like Intelligent Tutoring System (ITS). During that period, implementation of ITS was too challenging due to the limited computer and networking capabilities of those days. Bearing success in a few cases, ITS also failed to make a mark.

The latest technology entrant to the arena of education is the Web, as a combination of computers and communication technologies. These technologies exponentially increase the dimensions of quantity, speed, and accessibility in learning environments. Over the web, Teaching Learning Process (TLP) becomes easier, cheaper, faster, and more accessible. However, challenges crop up when developers of tutoring system move to technology adoption without giving adequate thought to pedagogic value, the content, the assessment mechanism, communication, collaboration mechanisms, etc. [Berge and Collins, 1995] acknowledge that information and communication technology (ICT) is changing instructional methodology in two ways: generating improved technological tools to use a full range of interactive methodologies, and more importantly – by focusing teachers’ perspectives on the appropriate learner-centered design of instruction. [Price, 1987] notices that, it is not the medium itself that determines the pedagogical outcome, but the specific focus of the theoretical approach on the language learning phenomena. Hence, LTS developer needs to understand the learning process in general, the teaching methodologies available and the role that technology can play to make the technology interventions effective.
In this chapter, we discuss the topic of language learning process, language teaching methodologies, and various frameworks used by researchers to develop today’s language tutoring system. The chapter also throws light on the prominent language tutoring systems available to learn foreign as well as Indian languages. The chapter ends with the analysis of existing systems with a view to evolving a proposal for our work.

2.1 Linguistics - Competence or Performance

Chomsky, 1965] came with the theory which suggests that to study language, one should give emphasis on linguistic competence rather than performance. This started a debate. [Spolsky, 1972] says, “Linguistic competence is not enough for practical or educational purposes; we are interested not just in the fact that someone knows a language but that he knows how to use it”. Due to the difficulty of applying Chomsky’s concept of competence directly to language teaching, Hymes’ theory of ‘communicative competence’ was found to be more acceptable to the applied linguistics field. [Hymes, 1972] argued that in addition to linguistic competence, the native speaker has another rule system. That is, he knows intuitively what is socially appropriate or inappropriate and can adjust his language use to such factors as the topic, situation, and human relations involved.

Hymes notion of communicative competence is taken further by [Canale and Swain, 1980; Canale, 1983] who form a model of second language teaching in which the communicative competence consists of four parts: grammatical, discourse, sociolinguistic and strategic.

[Widdowson, 1989] mentioned that actual use of language may depend more on stocks of lexical items rather than the analysis of structures. The grammatical competence may have very little to do with the actual use of language at all. It may be wise to still keep apart the competence in the form and that in the use of language. [Lyons, 1996] said that the ability to use a language is a kind of procedural knowledge (knowing how to do something) and this ability seems to be integrated with knowledge of the language or to come naturally as a result of knowing that language. In a way, remark of [Brown, 1996] on the competence-performance debate is important. She said, “Initially there is a competence which consists of fundamental
constraints on the nature of human languages. Then the child’s observation of the language which he or she hears (performance) begins to modify competence, and thus the process of modifications in competence is further carried in future performance”.

From the above discussion, it is clear that Chomsky’s view on linguistic competence alone can’t serve as the goal of language Teaching Learning Process (TLP). For TLP, both learner’s competence and performance are equally important. Competence is useful in setting and adjusting the pace of learning, whereas performance is useful in deciding the teaching strategies. We can’t teach students only the forms and grammar rules of language and expect them to deal with the performance issues by themselves. Actually, mapping of language forms to use does not come from theory, but is learned from experience; language teaching learning process should facilitate it. As mentioned earlier, Hymes’ remark on additional competence of a teacher beyond linguistic competence while designing a LTS is also significant. Since, in any learning environment, adjusting the learning pace as per the learner’s as well as subject requirement is an important factor. Brown’s opinion about language acquisition mechanism is consistent with the use of repetition and correction in children learning their first language – the model we are focusing on for this research. A reasonable conclusion about the competence-performance debate is that competence constantly develops with the modification of performance.

2.2 Language Learning Process

Learning is a generic term applied to the gathering of a variety of different know-how. Learning involves changes in attitude, beliefs, capabilities, knowledge structures and skills [Steeples and Jones, 2002]. There are different ways to categorise the different kinds of learning. Bloom’s taxonomy of learning is, perhaps, the most famous one. [Bloom, 1956] categorised learning into three types: cognitive - relates to learning of knowledge, affective - relates to learning of attitude, and psychomotor - relates to learning skills. These learning categories are further refined into different levels. For example, cognitive learning has six levels in which knowledge is at lowest level, moving up to comprehension, application, analysis, synthesis, and evaluation. Similarly, affective learning has five levels starting with receiving and then responding, valuing, organization, and characterisation. Although no taxonomy of
psychomotor domain was compiled by Bloom, several competing taxonomies have been created over the years since then. [Harrow, 1972] identified the levels in psychomotor domain as reflex, fundamental movements, perceptual abilities, physical abilities, skilled movements, and non-discursive communication.

With respect to the process of learning, there are different theories in existence. The most known among these are behaviorist, cognitivist and constructivist. Behaviorist sees learning as a change in observable behavior caused by external stimuli in the environment [Skinner, 1974]. Cognitivist model sees learning as an internal process that involves memory, thinking, reflection, abstraction, motivation and meta-cognition [Ally, 2004]. Constructivists consider learning as construction of knowledge by an individual, using the inputs received from learning environment and the existing knowledge that he possesses. According to [Ertmer and Newby, 1993], the three learning models can, in fact, be used as taxonomy for learning. Behaviorists’ strategy can be used to teach the “what” (facts), cognitive strategies can be used to teach “how” (processes and principles), and constructivist strategies can be used to teach the “why” (higher level thinking that promotes personal meaning, situated and contextual learning).

Research into language learning strategies began in 1960s, much of which was influenced by cognitive psychology. The focus of the research was to identify what good language learners do to learn a second language. The outcome was multiple strategies for language learning. [Wenden and Rubin, 1987] are the pioneers in the field of strategies followed by [Oxford, 1990] and [Stern, 1992]. According to Wenden and Rubin, there are three types of strategies used by learners for language learning. These are learning strategies, communication strategies, and social strategies. Learning strategies contributes directly to the development of language system constructed by learner. This strategy is further sub divided into cognitive and meta-cognitive. Cognitive strategies are analysis or synthesis of learning material which is required and used by a learner while solving a problem. These are further categorised into clarification, inductive inferencing, deductive reasoning, practice, memorisation, and monitoring. Whereas meta-cognitive strategies are used to self-direct language learning through various processes likes setting goals, planning, and self management. The focus of communication strategies is on conversation. Social
strategies provide opportunities for learner to apply their knowledge by participating in various activities.

According to [McLaughlin, 1984; Bialystok, 1994], language learning in processing terms, has many things in common with other types of learning. In order to get a better understanding of language learning process, it is necessary to consider the role of two core aspects of language learning – procedural knowledge and declarative knowledge [Banner and Rayner, 2000]. Declarative knowledge emphasises understanding whereas procedural knowledge looks at application. [Bialystok, 1994] has linked these two elements of learning to linguistic processing. He said that the cognitive process of analysis is related to declarative learning and that of control appears to be related to procedural learning. [Segalowitz, 1997] proposed a language learning model along a cognitive, information processing framework where progress in knowledge, linguistic performance and cognitive aspects are joined together. This model is interesting for various reasons. First, it coincides with the experience of language specialists, i.e. language teachers. Second, no matter how individual learners’ progress may evolve, the underlying processes, as judged from learners’ performance, are to be designed as a pedagogy as per learner’s extent of knowledge. Moreover, learner’s progress may be evaluated from his/her performance considering the nature of linguistic. Third, this learning model is in accordance with relatively direct relationship between processes of language comprehension and general cognitive processes.

However, learning cannot be restricted to model searching or the application of models. [Lessard-Clouston, 1997] mentions that the studies to be done on language learning strategies and strategy training should move beyond descriptive taxonomies of language learning strategies and attempt to seek answers to a wide range of questions, such as the following. What types of language learning strategies appear to work best with what learners in which contexts? How can one best assess and measure success in language learning strategies used for training? Are certain language learning strategies more effective in classroom and non-classroom contexts? What language learning strategies should be used at different proficiency levels?
2.3 Language Teaching Methodologies

Language Teaching Methodologies (LTM) is a set of practices for systematic teaching based on underlying theories of language and language learning [Richards and Rodgers, 1986]. Within LTM, a distinction is often made between methods and approaches, in which methods are fixed teaching systems with prescribed techniques and practices, whereas approaches represent language teaching philosophies that can be interpreted and applied in a variety of different ways in the classroom [Rodgers, 2001]. Here we are going to discuss only language teaching methods.

Methodology in language teaching is that which links theory and practice. Here, ‘theory’ means theories of what language is and how language is learned. Such theories are linked to various design features of language instructions. These design features include learning objectives, syllabus to be covered, teaching/learning process, role of teacher and learner, assessment and feedback mechanism, etc. There are eight language teaching methods in practice today. We present a summary of these eight methods next; for more details reader can refer [Larsen-Freeman, 2004].

2.3.1 The Grammar Translation Method

The grammar translation method is one of the most influential and persistent methods in the history of language teaching. This method is characterized by rote memorization of grammar rules. Classes are conducted in first language, with little active use of target language. Classroom activities consist mainly of exhaustive use of dictionaries, explanations of grammatical rules, some sample sentences and exercise drills to practice new structures. Vocabulary is taught in the form of lists of isolated words. Students learn language by translating sentences and passages from source language to target language. All activities in the class are controlled by the teacher, with little emphasis given on spoken language [Liu and Shi, 2007].

2.3.2 The Direct Method

Linguistic structural description of world languages, combined with behaviorist psychology gave rise to the direct method [Rodriguez, 2009]. The objective of this method is that at the end of language course students will learn to communicate in target language. The language that is taught in the classroom is ordinary, every-day
language; hence, lessons covered include communications in a bank, restaurant, railway station or any scenario where communication takes place in colloquial form. Since use of first language is discouraged, students are taught to associate meaning in the target language directly through the use of realia, pictures or pantomime. Classes are conversation-based and the teacher must be near-native speaker of the target language [Celce-Murcia, 1991]. Concrete vocabulary is taught through demonstration, objects, and pictures; abstract vocabulary is taught by association of ideas [Richards and Rodgers, 1986].

In the whole learning process, little emphasis is given to cover a grammatical syllabus, and if there is any, it is inductive in nature by generalizing from the practice and experience with the target language. Student knowledge is tested through actual use. The whole idea of this method is that second language learning should be more like that of first language learning.

### 2.3.3 The Audio-Lingual Method

With the advent and popularity of audio tapes during 1950 – 1960, this method emerged. Focus of the method was on the collection and analysis of spoken data according to structured system of phonemes, morphemes, words and sentence types [Richards and Rodgers, 1986]. Classroom activities are centered around intensive drills, focusing on pronunciation. Grammatical structures are generally presented through dialogue and students learn it through imitation, repetition and drills. Since, Audio-Lingual Method emphasises on grammatical and phonological structures, the vocabulary needed to be relatively simple, with new words introduced only as they are needed to make the drills possible [Decarrico, 2001]. The idea was that vocabulary would take care of itself once the students learnt the grammatical structures. This method was strongly influenced by Skinner’s behaviorist view towards learning. The role of the teacher is that of a language modeler and drill leader.

### 2.3.4 The Silent Way

[Gattegno, 1972] came with a new technique called ‘the silent way’ where in the teacher remain silent while students learn the language on clue through perpetual prompting. The silent way belongs to a tradition that views learning as a problem
solving, creative, discovering activity, in which the learner is the principal actor rather than a bench bound listener [Bruner, 1966].

In this method, language is seen as a group of sounds arbitrarily associated with specific meaning and organized into sentences or strings of meaningful units by grammar rules [Richards and Rodgers, 1986]. The sentence is the basic unit of teaching. Students are presented with the structural patterns of the target language and learn the grammar rules in a largely inductive way. The lessons are planned around grammatical items and related vocabulary. Language items are introduced according to their grammatical complexity and the ease with which items can be presented visually.

The teaching materials consist mainly of a set of coloured rods, colour coded pronunciation and vocabulary wall charts. The coloured rods are used to associate words and structures with their meaning in the target language. Rods are used for naming colours, size comparisons, etc. In case student or teacher finds it difficult to express a desired word or concept using rods, then they refer to the Fidel charts and also the vocabulary charts.

Language learning starts with sounds, which are introduced through colour-coded phonic chart having vowels and consonants cluster followed by lessons on pronunciation. Depending on the level of student, lessons on phrases or even sentences designated on Fidel charts are introduced. The teacher models an utterance with the help of rods through visual effect. Now it is student’s turn to produce the utterance. If the utterance is not correct, the teacher will reshape the utterance or present the correct model to another student. Here, the teacher’s strict avoidance of repetition forces alertness and concentration on the part of the learners [Gattegno, 1972]. If a structure is understood, the teacher set up situations, in which students can practice the structure through the manipulation of the rods.

2.3.5 Suggestopedia

[Lozanov, 1978] came with a method called suggestopedia – the application of power of ‘suggestions’ to the field of pedagogy. Lessons are conducted in an especially melodic and artistic way having relaxed learning environment. The teacher reads the text for learning and students look at the text which is prepared both in the target
language and in native language [Richards and Rodgers, 1986]. Later, students practice the language through activities such as dramatization, games, songs, and question and answer sessions. Peripheral learning is encouraged through posters and decoration containing grammatical information of the target language. During teaching learning process, emphasis is given on content and not on structure. Grammar and vocabulary are presented and given treatment from the teacher, but not dwelt on. Teacher has complete authority and control over the classroom.

2.3.6 Community Language Learning

Community Language Learning (CLL) also called as Counseling Language Learning was created by Charles A. Curran. The aim of this method is to remove the anxiety from learning by changing the relationship between the teacher and student. So, [Curran, 1976] proposed the Counseling-Learning educational model for language learning. CLL view of learning is a holistic one, where, learning a language is not viewed necessarily as an individual accomplishment but rather as a collective experience. The language-counseling relationship begins with the student's linguistic confusion and conflict. Then slowly the teacher-counselor strives to enable him to arrive at his own increasingly independent language adequacy. Students choose what they want to learn in the target language through various activities like translation, group work, recording, transcription, analysis, reflection and observation, listening, and free conversation. Self evaluation would be encouraged for student to make them self aware of their own progress.

2.3.7 Total Physical Response Method

Total Physical Response (TPR) is a method of teaching language using physical movement to react to verbal input in order to reduce student inhibitions and lower their affective filter [Asher, 1982]. In this method, teacher gives command and students follow it by ‘acting out’ the command. Teacher often uses a novel idea along with humor in their instructions.

In classroom teaching, emphasis is given on vocabulary and grammatical structures of the language which are embedded within imperatives [Larsen-Freeman, 2004]. The imperatives are single words and multi-word chunks, which are frequently occurred in
the speech directed at young children learning their native language. Hence, they are used to transfer or communicate grammatical features.

Students learn through observing actions as well as performing actions themselves. The students’ understanding of the target language is developed before speaking. Students will start to speak when they are ready. Teacher can evaluate students by commanding them to perform a series of actions.

2.3.8 The Communicative Language Teaching

Communicative Language Teaching (CLT) began in Britain in the 1960s. The goal of this method is to enhance communicative competence of the student. The emphasis is given on the form and communicative proficiency rather than on mere mastering of structures. It encourages activities that involve real communication and meaningful tasks. The classroom activities are often task-based or realia and involve real communication to promote learning. Learner performs all classroom activities in pairs or groups. Learner learns a language by using it to communicate. Here, learning is considered as a process of creative construction and involves trial and error. Language learners are expected to be negotiators, teachers to be an organizer, a guide, an analyst, a counselor and a group process manager.

2.3.9 Observations

Each of these methods discussed so far has some interesting elements and has attempted to deal with some issues of language learning. All these methods are not equal in power with respect to design features of language instruction, but each of them has its own niche strengths. We analyse here each one briefly on the basis of these features.

Direct method, audio-lingual method, CLT and TPR does not use supporting (native) language in the classroom. TPR even suggests that first language learning is the only successful way of language learning; so same model should be followed while teaching second language. In this connection, direct method demands innovativeness on the part of teacher, who develops new techniques such as demonstrating pictures and objects, emphasis on question and answer, dictation and imitation, etc. Silent way and suggestopedia observes that adults have different brains, interest, etc. and so they need different learning environments than children. Pedagogy wise CLT is rich.
Language is taught through varied number of activities like conversation, dialogues, drills, sentence patterns, visual cues, taped cues, and pictures, a variety of interactive patterns like pair work, group work, games, and role plays, language-based realia such as signs, magazines, advertisements and their symbols, graphics, and statistics [Erton, 2006].

Most of the methods (e.g., grammar translation method, direct method, audio-lingual method, suggestopedia, and TPR method) emphasise the vocabulary and grammatical aspects of the language. The silent way emphasises structural pattern in teaching whereas CLT covers the form of language. In contrast to all these methods is CLL where, as per the student’s need particular aspect of language is taught in classroom.

Some methods see the teacher as ideal language model and the commander of classroom activities (e.g., grammar translation method, audio-lingual method, suggestopedia, and TPR method) whereas others see the teacher as a facilitator and classroom colleague in learning process (e.g., direct method, the silent way, CLL method, and CLT method).

Assessment or evaluation is one of the important aspects of effective learning environment. Assessment is included as a part of learning to evaluate the performance of the learner. Assessment is useful in providing feedback and guidance to the learner; it is also useful for teacher to devise new teaching strategies for learner on the basis of his performance. Evaluation process followed in case of audio-lingual method is better. Various means like gap filling exercise, discrete point tests in which students distinguish between two words, etc. are used to evaluate student’s knowledge. Suggestopedia and CLL method discourage student’s evaluation whereas others don’t have any evaluation technique worth to mention here.

None of these methods provide proper response to student’s mistake. Each method has its own way to respond to student’s mistake. Grammar translation method places heavy emphasis on correct answer, which is provided by teacher. Direct method encourages self correction whenever possible. The teacher who follows audio-lingual method strives to prevent students from making mistake by predicting trouble spots. Other methods follow the philosophy that errors are inevitable, natural and indispensable part of learning.
2.4 Language Tutoring System: Review of Frameworks

The emergence of the World Wide Web in the early 1990s marked a significant change in the use of communications technology for all computer users. This opened up access to many authentic foreign-language websites to teachers and students that could be used in a variety of ways. Initially, web browsing was used in unstructured way which leads to wastage of time. But language researchers responded by developing more structured activities and online exercise. [Gamper and Knapp, 2002] provides detailed analysis on various Artificial Intelligence (AI) techniques adopted by researchers in CALL systems. In this section, we look at the prominent frameworks such as Constructivist Learning Environment (CLE), CALL and ITS that are useful in building an effective e-learning environment for language learning. We also discuss their role in terms of opportunities and challenges in the development of LTS. In addition to these language learning frameworks, the field of Natural Language Processing (NLP) is another important component in language learning research. NLP, as a field, deals with applications and techniques focused on natural language (as opposed to artificial computer programming languages); and provides mechanisms for effective analysis of language constructs – a hard problem in general. We briefly look at this topic first, and then look at the frameworks.

2.4.1 Natural Language Processing

Natural Language Processing is a range of theoretically motivated computational techniques for analyzing and representing naturally occurring texts at multiple levels of linguistic analysis for the purpose of achieving human-like language processing for a range of tasks or applications [Liddy, 2003]. Key contributing areas to the discipline and practice of NLP are linguistics, computer science and cognitive psychology. The focus of NLP is on two distinct fields, language processing and language generation. The first one refers to the analysis of language for the purpose of producing a meaningful representation, while the latter refers to the production of language from a representation.

There are multiple types of language processing known to be at work when humans produce or understand language. It is thought that humans normally utilize all levels
of language. These levels are phonology (lowest), morphology, lexical analysis, syntactical analysis, semantic analysis, discourse, and pragmatic. Various NLP systems utilize different levels, or combinations of levels of linguistic analysis. Current NLP systems tend to focus on mainly the lower levels of processing. The higher levels such as discourse and pragmatic are extremely challenging open problems today.

Various approaches to NLP can be categorized into three types, namely, symbolic, statistical, and connectionist. Symbolic approaches perform deep analysis of linguistic phenomena. The approach is based on explicit representation of facts about language through well-understood knowledge representation schemes and associated algorithms. Good examples of symbolic approaches are seen in rule-based systems, and semantic networks. Statistical approaches make use of various mathematical techniques, using large text corpora to develop models of linguistic phenomena. A commonly used statistical model is the Hidden Markov Model (HMM). Typical applications of statistical approaches are seen in speech recognition, lexical acquisition, parsing, part-of-speech tagging, collocations, statistical machine translation, statistical grammar learning, etc. A connectionist approach uses a model which is a network of interconnected simple processing units with knowledge stored in the weights of the connections between units. The connectivity between units reflects the relationship between them. These models are well suited for tasks such as syntactic parsing, translation, and associative retrieval.

[Nerbonne, 2002] has enlisted applications of NLP to CALL, e.g., concordancing, lemmatization, text alignment, speech recognition and synthesis, morphological processing, and syntactic processing. If corpora are integrated with LTS, then it is useful to identify linguistic patterns and give an elaboration on distinction between them. A corpus based LTS become more effective, if it is supplemented with concordancing and lemmatization [Wichmann et al., 1997].

Morphological processing is useful in dictionary lookup of words unknown to readers and also makes corpus access more flexible. NLP has been useful in LTS for constructing a sentence from a list of words, and also in order to generate dialogue [Pasero and Sabatier, 1998]. A parser provides ways to clarify and identify syntactic structure of a sentence, and also to spot and diagnose errors in learner’s response.
Without parser, error correction is generally carried out by rote matching techniques. Hence, the possible answers recognized by the program must be severely restricted since they are multiple choice or fill-in-the-blank exercises. The trouble with such exercises is that the specific errors which the students would have produced may not be included in the narrow range of errors envisaged or admitted by the program. NLP capability allows students to type any sentence in response to any exercise and still carry out adequate analysis to generate detailed feedback regarding any errors they produce. For this reason, NLP technology represents a dramatic step forward for CALL [Holland, 1995].

Finally, we can say that NLP is useful in analysis, generation, learning and evaluation or assessment of language data in LTS.

2.4.2 Constructivist Learning Environment

The active participation of learner in the learning process has become the basis for new directions and learning theories since seventies. Constructivism followers took it further as one of the key element in learning. Constructivism emerged as a teaching and learning approach against the traditional behaviorist approach which was widely practiced in 18th and 19th century [Mathews, 2003]. Behaviorist approach follows a traditional teaching model where set of instruction sequences are used by a teacher to teach a particular subject. Teachers are able to predict the outcomes of the instruction based on the notion that they control what students will learn by linking student responses from lower level to higher level skills [Ruschoff and Ritter, 2001]. In this process, little emphasis is given on the students’ current knowledge state, practicality or significance of the content. We, today, know that learning is the process of knowledge construction. [Tapscott, 1998] states that in today’s world learning is moving away from one-way instruction to construction and discovery of knowledge. The behaviorist model falls short in preparing student to be critical thinkers which is one of the reasons for the shift from behaviorist to constructivist model.

In Constructivist Learning Environment (CLE), the learner mainly learns through observations, processing and interpretation. They discover their own answers and produce their own concepts where the instructor plays the role of advisor or facilitator. In CLE, learner is allowed to create knowledge in an individually unique
way rather than being given knowledge through instructions [Duffy and Cunningham, 1996]. The core of CLE is a framework that provides a supportive, safe and motivating environment where learners may work together and solve problems, interact, support each other and assesses their learning using variety of tools and information resources [Jonassen, 1994; Wilson, 1996].

The potentials of CLE lie in it being student centric, constructive and collaborative in approach [Jonassen, 1994]. These are particularly useful while teaching a language using non-grammar based approach. CLE can provide a place where student can experiment with various grammatical constituents of the sentence and can see their effect on other constituents. During this process, student internalises the relevant concepts and builds his own model of sentence construction. The playing ground can take a variety of forms from simple descriptive problem solving to simulated building of a device [Sasikumar, 2006].

CLE holds substantial promises in various aspects and concerns of instruction design and prescription of it in an effective e-learning system is proposed by [Merril, 2002; Clark and Mayer, 2008].

2.4.3 Computer Aided Language Learning

CALL is concerned with the use of computers in language learning. The idea of using technology and instructional media in language classroom is not new and it has been a common practice for a long time [Salaberry, 1996]. During early days of CALL, one of the best-known computer aided tutoring system was PLATO, [Ahmad et al, 1985]. It was used for drill, grammatical explanations and translation tests. Various types of CALL also began to become more commonplace. One of the main promises shown by all these CALLs is the ability of individualised learning, a learning environment which supports personal development and learning, in learner’s own individual learning pace [Warschauer and Healey, 1998].

Most of the CALL programs work by presenting a stimulus to the learner eliciting a response from the learner. The stimulus may be presented in any combination of text, still images, sound and motion video. The learner responds by typing a text or speaking into a microphone. The computer analyses the response and shows errors, if any. In the early days of CALL, many teachers focused on technological issues,
neglecting pedagogical and methodological issues which are actually required to be blended properly. [Bannert et al., 2003] states that CALL system shows a promising situation in which pedagogical, methodological principles and technological potential are brought together. Over the years, CALL has come up with a number of pedagogical models useful for language learning, viz., situated learning, immersive learning etc.

The design of CALL materials generally takes into consideration the principles of language pedagogy and methodology, which may be derived from different learning theories (e.g. behaviorist, cognitivist, and constructivist) and second language learning theories. Behaviorist learning model emphasise rote learning or memorization. In contrast, situated learning emphasises the idea that much of what is learned is specific to the situation in which it is learned [Lave, 1988; Lave and Wenger, 1991; Greeno et al., 1992]. Situated learning follows a problem solving approach, a goal oriented activity on the basis of certain context in which learning takes place side by side. The core elements of situated learning are intrinsic motivation, active learner and collaborative learning. Situated learning does not follow the linear approach to instruction which is commonly seen in case of behaviorist approach. Some of the problems with the situated learning are: the development time is very long for situated learning program; the success of the program heavily depends on the concept of active and motivated learner; and less efficient in the context of abstract and complex concepts [Lunce, 2006; Hung and Chen, 2002].

Immersive learning has been around as long as there have been reasons to include context, application and practice as a part of the process of knowledge acquisition [Johnson and Levine, 2008]. Immersion in language learning is the situation where the learner spends time in an environment operating solely in the target language. Role playing scenarios, case studies and simulations and non linear narratives are forms of immersion. Immersive environment has a potential to engage students who are not reacting well to current teaching practices. For a learner, the immersive learning will really propel his learning ahead, particularly if he communicates exclusively in the target language.
As the technology advanced, we began to see more interactive uses of CALL as well as an increase in the integration of various media into the computer system [Pusack and Otto, 1990]. A recent development of using corpora for language teaching in a computerised environment is actually making the most of CALL in an unprecedented way, in terms of its ability to exploit authentic language usage. Today, the use of multimedia, the Internet (especially the World Wide Web), and various forms of distance learning are widespread. Interest in using them as tools to support language learning is growing, both from the perspective of a language educator and that of a language learner.

Still, the impact of CALL in the field of language learning is modest. The reasons are many: current CALL systems have not addressed the important issues in language learning like lack of a unified theoretical framework for designing and evaluating CALL systems for linguistic analysis of input text; integration of linguistic tools in teaching/learning process [Chapelle, 1997; Hubbard, 1988; Ng and Olivier, 1987]; inadequate framework for analysing student’s mistake and feedback mechanism [Sasikumar and Joshi, 2007], etc.

The seven criteria suggested by [Chapelle, 1998] for developing CALL also present interesting challenges. The criteria are (1) making key linguistic characteristics salient, (2) offering modifications of linguistic input, (3) providing opportunities for ‘comprehensible output’, (4) providing opportunities for learners to notice their errors, (5) providing opportunities for learners to correct their linguistic output, (6) supporting modified interaction between the learner and the computer, and (7) acting as a participant in Second language tasks.

2.4.4 Intelligent Tutoring System

ITS is described in terms of two major components, namely, ‘intelligence’ and ‘tutoring’. Here, ‘tutoring’ means practice as the preferred method of learning, and ‘intelligence’ enables the system to analyze the student’s current state of knowledge and accordingly plan next set of lessons, tracking of student progress, error diagnosis in learner’s approach, etc. Based on cognitive science and artificial intelligence, ITS has proven their worth in multiple domains in education [Sykes and Franek, 2003].
Intelligent Tutoring Systems, in many respects, try to mimic human tutors. They usually consist of the following core models [Swartz and Yazdani, 1992]: (1) an expert or domain model which stores the domain knowledge, (2) a learner or student model which describes the learner’s or student’s current knowledge about the domain and allows the tutor model to plan the interaction between the student and the system, (3) a tutor model which represents the tutoring strategies and learning goals, and (4) a graphical user interface. Architecture of a typical ITS is shown in Figure 1.

![Figure 1: Architecture of ITS.](image)

A student learns from an ITS primarily by solving problems which are, normally, generated by the system. The system compares student response with its own solution, identifies problem areas, and gives appropriate feedback. Here, analysis of student response is an important aspect of ITS. ITS decides whether the solution is correct or not, finds out what exactly is wrong or incomplete, and possibly identifies which missing or incorrect knowledge may be responsible for the error.

Mean time, the system updates the student knowledge state and skills. Also it considers what the student needs to know, which part of the curriculum is to be taught next, and how to present the topics. Using all these, it decides the next course of action. The effectiveness of ITS heavily depends on how well the expert, student and tutor model are integrated.

In many ITS systems, a lesson is selected by a student, while learning tasks within this lesson are adaptively selected by the system. Some systems can only manipulate the order of task of one particular kind: usually problems or questions. In this case it
can be also called problem or question sequencing. Adaptivity, that is presenting the topic to the learner as per his current knowledge state, interest, learning ability or preference, etc, is an important task. This task may be done as a part of content delivery, generally, seen in many e-learning systems, or in response to student’s difficulties noticed while solving a problem. Both come under the tutor model as teaching strategies. Here second approach is more effective from the point of teaching learning process but more difficult to implement.

Despite the many strong points of ITS, language learning using ITS also has not taken off as expected, mainly because research is primarily driven by computer scientists and doesn’t address all the different issues from other fields [Kinshuk, 2002]; difficulty in representation of linguistic knowledge in expert and student model [Chanier et al., 1993]; no standard language for representing knowledge and tools to manipulate the knowledge [Self, 1999]; and inadequate analysis of students response and suggesting appropriate remedial measures to correct mistakes and also deciding the right time and type of intervention required when students make mistake [Sasikumar and Joshi, 2007].

ITS has powerful ideas to address many of the challenges raised in section 1.3 to some extent. Separating the various aspects of TLP into student-tutor-domain models, as done in ITS, is a powerful way to structure these components and useful to build in aspects such as adaptivity, etc.

Interactive problem solving support in ITS can provide a student with intelligent help at each step of problem solving. The level of help can vary from signaling about a wrong step, to giving a hint, to executing the next step for the student. This is useful to understand various aspects of intervention (type, time, etc.) which is required when student makes a mistake. Also, it is useful to provide help and to update the student model.

Generally, ITS has detailed domain model over which reasoning and analysis is possible and which is useful in analysing student’s mistake. Tutoring component is the driving force of ITS. If coupled with feedback mechanism, it is useful in tracking student’s progress.
ITS also allows various modeling aspects involved in the case of personalised tutor, enhancing the real capability of e-learning which makes learning beyond what is possible in a classroom.

2.5 Current Tutoring Systems for Foreign and Indian Languages

A number of Language Tutoring Systems have been developed so far using different techniques. Some of them are freely available where as for the rest you need to pay. This section analyses the LTS, mostly those which are freely available. When we started our research MarathiMitra, school4all, LILA, Punjabonline, and Marathi Tutor etc, were available in the area of language tutoring. Linguata, CSIEC, Mymarathi, marATHI e-shALA etc. are relatively new, and came up alongside our work. First, we discuss the LTS available in foreign language and then LTS available in Indian languages.

2.5.1 Linguata

Linguata software covers languages including Arabic, Chinese, French, German, Hindi and many more [Linguata, 2010]. One can use this software to learn words and phrases. To teach language, it follows situation based learning model. Learner can select a subject in which he wants to develop his proficiency in a chosen foreign or Indian (Hindi) language. Then a list of words in foreign language and corresponding words in English comes on a screen. By clicking on the word, one can hear the pronunciation of the word. By practicing this session, one can get well versed with the pronunciation as well as spelling of the words and phrases.

Learners can also take a test. There are different types of tests provided which is a combination of sophisticated testing and simple games. These tests or practice sessions includes: (1) flashcard learning, (2) spelling practice, (3) multiple choice questions, (4) phrase building, (5) unscrambled words, and (6) practice and test listening, comprehension and pronunciation skills. Each test has its own difficulty level. A progress tracker allows the learner to measure his progress by keeping track of his score. The feedback mechanism is poorly implemented. If a student makes any mistake, then he will be informed that his answer is wrong. No help is provided to student about the mistake he has made and how to correct it.
2.5.2 Mango Languages

Mango Languages offers twelve foreign language courses which include Chinese, French, German, Greek, and Latin [Mango Languages, 2008]. Lessons are based on phrases and dialogue. Each language program is divided into 100 lessons. Before each lesson, detailed grammar instructions are provided. The main problem with Mango Languages is that the entire lesson planning is mostly receptive i.e. you need to simply listen and repeat what you heard. For self testing, quizzes and flashcards are used but they are not very effective and hence no real productive exercise takes place.

2.5.3 LangMaster

LangMaster has provision to learn German, French, English, Italian, Spanish and Russian language [LangMaster, 2009]. One can improve his reading, writing and listening skills in above mentioned languages and strengthen his vocabulary. Language is taught using didactic method. All lessons are taught in target language only. Features, such as speech recognition, pronunciation practice using voice curves, method for vocabulary building, and many others are used to master the language. A test is provided to check knowledge of vocabulary and grammar. If student’s answer is wrong, it displays the correct answer and points out where he has made a mistake, be it in letter, word or grammar. Also it suggests suitable exercises to overcome student’s lacuna.

2.5.4 LinguaTv

This software can be used to learn English, French, German, Spanish and Italian languages [LinguaTv, 2010]. The learner can get well versed with words and phrases in above said languages. It uses audio-visual content for teaching. A series of professionally produced training videos are shown to the learner. The video consists of how a native speaker uses particular language. The video also contains cultural aspect of communication along with grammar of the language. The learner has to rehearse these words and phrases later.

An extensive range of training videos and interactive exercises makes it possible to learn the language as per learner wish. The assessment is carried out in various ways including comprehension questions, crosswords, puzzles, dictation, fill in the blanks
etc. No provision is made to track student’s progress and feedback mechanism is poorly implemented.

2.5.5 Computer Simulation in Educational Communication

[Jiyou, 2009] developed Computer Simulation in Educational Communication (CSIEC), a web based human computer dialogue system for English language. Through CSIEC one can learn words, phrases as well as sentences. The teaching model followed here is immersive learning and implemented through scenario show and chatting. The chatting function allows user to chat with the system either through text or speech. The chatting can be either free (unlimited) or on given topic (limited). Both kind of chatting facilities are available keeping in mind different types of user and different kinds of chatting patterns. Chatting topic is generated on the basis of user’s profile. If the user doesn’t want to chat on the generated topic, then he can change the same.

A gap filling exercise is used as a self test for user to check his grammatical knowledge where user is supposed to fill the gaps by correct answer. If the student’s answer is not correct, then system informs it accordingly. The feedback mechanism is poorly implemented. No help is provided to user about the type of mistake, and how to correct it.

2.5.6 MarathiMitra

It is one of the largest websites on the Internet to teach spoken Marathi. The website has compilation of the most commonly used words and expressions in English and the pronunciation of their Marathi equivalent [MarathiMitra, 2011]. To learn Marathi, one can jump to the words or sentences right away; but it is suggested to get familiarised with the pronunciation keys, first. Different sections in this site are conversations, expressions, quick reference, grammar, word list, articles, and forum. Grammar section contains set of rules for noun, verb, adverb, pronoun, adjective, modifiers and conjunction. This website lacks pedagogical aspects of language learning. Learning Marathi using this website is similar to learning through book except that one can get familiar with pronunciation of words. This website doesn't enter into interactive learning and hence there is no teaching-learning process worth mentioning.
2.5.7 School4all

Dnyandeep Education and Research Foundation have launched this website to provide free education to all under the direction of Government of India [School4all, 2010]. The idea is to search and provide useful and relevant free educational and informative links available on the internet. The Marathi section of this site contains link for Marathi grammar, text book from 5th standard to 8th standard, and stories and poems for children. Marathi grammar section provides information about phrases, list of correct Marathi words, collective nouns and eighteen rules for writing correct sentences in Marathi. This website also does not enter in a teaching mode. No assessment mechanism for self test; so needless to talk about any feedback and progress tracking.

2.5.8 Mymarathi

This website is an attempt to bring all Marathi related informative links on one platform. This site has links for Marathi Dictionary, information about Marathi language, Marathi books, Marathi Audio, Marathi E-magazines etc [Mymarathi, 2006]. From the language learning point of view, it contains Marathi alphabets, eighteen rules for writing correct sentences in Marathi, collective nouns, idioms, proverbs and list of correct words in Marathi. Learning through this website is like learning from a book without teacher. In this website, no assessment provision is made for self testing.

2.5.9 marATHI e-shALA

This website is designed to teach Marathi at three different levels: preliminary, intermediate and advanced [marATHI e-shALA, 2006]. These levels indicate the type of reading material available for practice from ‘basic’ to ‘advanced’ for learner to learn the language. Preliminary level consists of prayers, Marathi alphabets, counting up to 12, days of week, Marathi months, songs, poems, etc. Intermediate level consists of stories, poems, drama, documentaries on nature, etc. Advanced level consists of essay, stories, documentaries, interviews, poems, literature, etc. Learner is supposed to view the material on his computer or he can also take print out of it and read it. This website also never enters in teaching mode. No assessment mechanism is provided to test knowledge at any point.
2.5.10 LILA

This is one of the best initiatives taken by Government of India to teach Hindi language to any person through fourteen different Indian languages. The present LILA (Learning Indian Languages through Artificial intelligence) has Hindi Prabodh, Praveen and Pragya packages through which it offers a user-friendly and effective tool on the World Wide Web to learn Hindi through the medium of Assamese, Bodo, Bangla, Gujarati, Kannada, Kashmiri, Malayalam, Manipuri, Marathi, Nepalese, Oriya, Punjabi, Tamil and Telugu [LILA, 2006]. LILA is a dynamic and interactive tutoring system with audio, visual and video support. LILA can be used by individuals and also by groups of learners. The pedagogical principles are taken care to some extent. The course introduces alphabets, vocabulary and then sentence constructs which are supported with images, audio and video. Assessment mechanism is provided to test the knowledge at the end of every lesson. LILA also lacks feedback mechanism which is necessary whenever students make mistake.

2.5.11 Punjabonline

This website helps anyone to learn Punjabi language with its writing script, pronunciation and grammatical assistance [Punjabonline, 2007]. This website includes examples which explain rules for formation of words, sentences along with its meaning written in English for easy learning. This website covers the basic structure of every word including formation of individual word and its pronunciation. To learn a language quickly, an image of a word is displayed along with its name written in Gurumukhi. But, the teaching component is missing and website looks like a compilation of ‘Punjabi’ grammar book. Assessment is also carried at small scale which includes the exercise on identifying correct alphabet for given script. No feedback mechanism is implemented.

2.5.12 Marathi Tutor

Marathi Tutor is a web-based constructivist learning environment for teaching spoken Marathi [Rane and Sasikumar, 2006]. The system covers a course on Marathi language which is divided into number of lessons. The course starts with an introductory lesson on the pronunciation key for Marathi, then moves on to lesson on
basic vocabulary and moves to expressions concluding with full fledged conversations.

### 2.5.13 General Observations on the Language Tutoring Systems

All of the tutoring systems presented above share general common features like good vocabulary, audio for pronunciation, script of the target language, basic grammatical constructs, expressions, conversations etc. The biggest issues with Indian LTSs are that they are very formal and tacit. These systems lack depth in teaching learning process. CSIEC and Marathi Tutor covered sentence level teaching. But, the feedback mechanism in almost all the systems is trivial. When the student’s answer is wrong or he makes mistake, then these systems are unable to let the student know, where he has made the mistake, rather, the answer from the system is simply ‘your answer is wrong’. This philosophy is as good as taking a grammar book and mugging all the rules. Most of the systems seen above lack intelligent component in them, they don’t enter into serious learning process which is required for deep understanding in any language. We look at the design of our proposed framework keeping in mind these aspects.

### 2.6 Building an Intelligent Environment for Learning Indian Languages

Having looked at the language learning process, various teaching methodologies available to support language learning, the major frameworks in the development of LTS and analysis of currently available foreign and Indian LTS, we now put forward our problem definition and look at how to build an effective LTS. Our approach of language teaching is based on the model of children learning their first language where no visible attempt is made on explicitly teaching grammar rules. Such grammar rules are instead meant to be learned implicitly by learner during the learning process through repetition and practice, right time intervention, and appropriate feedback. Our research focuses on a framework, associated data structures and algorithms, to address all these three aspects. Our system, which is denoted as IELIL (Intelligent Environment for Learning Indian Languages), is an attempt in that direction. None of the system that we have seen addresses these concerns coherently.
One can also use grammar based approach to teach the language. In this approach, the students have to learn the grammar rules explicitly for the development of all language skills – speaking, listening, writing, and reading. Considering the various reasons of language learning as stated in chapter 1, most of the language learners want to be familiar with reading and speaking skills for communication purpose. Since study of whole grammar rules is a time consuming task, which makes language learning process uninteresting for students. Hence, for most of the students, learning a foreign language using grammar based approach is often difficult, sometimes virtually impossible. In this situation, effective instruction includes systematic practice, plenty of opportunities for interaction/conversation and teaching grammar rules inductively. This is similar to the model of children learning their first language. Hence, we adopted it in the development of IELIL.

IELIL approach is general enough where in a student can learn any language. Currently we are working on Marathi; we expect the framework to be extendable to any Indian language. IELIL should provide individualised tutoring. IELIL must be capable of proper analysis of student interaction to keep track of student’s progress and to detect student’s mistake if any, which is of essence in problem solving approach. Design features of the system are derived from the constructivist approach, internal grammar representation techniques, and the principles of first language learning. Unlike the other systems, IELIL focuses on making the user comfortable with Marathi to the best extent possible. We call the specific system we are implementing as Marathi-Eguru.

Our approach integrates the potentials of three areas of prior research, namely, Constructivist Learning Environment (CLE), Computer Aided Language Learning (CALL) and Intelligent Tutoring System (ITS), described in section 2.4. These areas are having their own strengths and have made useful contributions in teaching languages. CLE provides a powerful environment or place where student can play around as he wishes and while playing he learns the language. CALL is a problem solving approach for language teaching and learning and it supports individualised learning. ITS approach sees learning as a problem solving process rather than as a reinforcement process. ITS addresses effective representation of domain (language) knowledge necessary for pedagogical decision. ITS’s feedback mechanism is useful
to keep track on student’s progress which is very much essential in problem solving approach.

There is no significant work done in Indian LTS with respect to exploiting these three threads together: CLE, CALL and ITS. Our research focuses on developing a generic architecture that helps a student in learning Indian language. Details of our approach are given in the next chapter.