2 LITERATURE REVIEW FOR THE STUDY

2.1 Introduction

Computer-based Instruction (CBI) systems that display some degree of "intelligence" have been used in educational systems for over two decades [1, 132]. Computer-based Training (CBT) and the first generation of computer-assisted education tools were called, Computer-aided Instruction (CAI) were among the first such systems that were introduced to teach students using computers [93, 117, 131]. One of the early examples of such a tutoring system is the system by Uhr in the year 1969 [147]. This system generated problems on arithmetic and questions on vocabulary. Some studies show that traditional CBT and CAI can be superior to traditional classroom instruction [106].

While both CBT and CAI may seem to be effective in helping learners, they are incapable of providing user modeling or adaptation technique, individualized attention and feedback as a human tutor would have given to the students [81, 119, 124, 131]. However, some contemporary systems, like Suppes (1967), system by Woods and Hartley (1971) could be called adaptive because the problems were according to the user's performances [147]. But the user model they used was quite primitive in nature. The model was only a parametric summary; the actual knowledge state of the user was not stored.

These systems can be termed as the pioneers to Intelligent Tutoring System (ITS). Thus, a new field of research has emerged to this problem is the use of novel software known as ITSs, with built-in artificial intelligence. These systems, which adapt themselves to the current knowledge stage of the
learner and support different learning strategies on an individual basis, could be integrated with the Web for effective training and tutoring.

The ITS is a learning technology that dynamically adapts learning content to objectives, needs, and preferences of a learner by making use of his expertise in instructional methods and the subject to be taught. The ITS offers the flexibility in presentation of material and a greater ability to respond to individual student needs in a similar way to which a human tutor would. The “intelligence” that the ITS achieves is done by representing pedagogical decisions about which teaching technique to use, as well as information about the student or user. There are several ways of categorizing ITSs, including the abstraction of the learning environment and the knowledge type of the instruction.

The ITS also a software system that uses AI techniques and tutors people in a given domain [37, 81]. Early ITS software systems focused on the development of student modelling approaches, and rarely evaluated the methods properly. The goal of ITS now days is to provide a learning experience for each student that approaches the standard of learning that he would receive from a human tutor [8, 25, 30, 58, 74, 128]. To achieve this goal, ITS software monitors each student’s interactions and builds a ‘student model’ for individual [109, 116, 146].

This model comprises the student’s performance on training/problem-solving and remediation exercises; knowledge of all information and remediation received; the knowledge mastered, failed and misunderstood by the students; and the student’s learning style. Apart from the student model, two other important models in an ITS includes the domain model and the tutor model. The domain model represents the knowledge of the domain while the tutoring model contains methods on how to select, sequence and present materials to the students [8, 113, 169]. More
detailed discussion about these models are presented by the researcher in Chapter 3.

These systems are also intended to facilitate learning-by-doing: transforming factual knowledge into experiential knowledge [11, 139]. They attempt to combine the problem-solving experience and motivation of “discovery” learning with the effective guidance of tutorial interactions. To enable this, the system must have its own problem-solving expertise, its own diagnostic or student modelling capabilities and explanatory capabilities. In order to organize these reasoning capabilities, it must also have explicit control or tutorial strategies specifying when to interrupt a student’s problem-solving activity, what to say and how best to say it; all in order to provide the student with instructionally effective advice [150].

2.2 ITS in Educational System

ITSs are remarkable with regard to their methods and the fundamental theories used. Their origin comes from the field of Computer Assisted Learning and can also be found in the Artificial Intelligence (AI) movement of the late 1950’s and early 1960’s. Since the early 1960s, computers have been employed to achieve a variety of educational goals for students and teachers [77, 84, 108, 131]. Some of these goals include automated testing and routine drills, tutorials, simulations and practice tasks that have been mechanized with earlier technologies [10, 92, 131].

CAI programs engage the students in challenging and entertaining reasoning tasks and capitalize on multimedia capabilities to present in formation [85]. Where as CBI has successfully penetrated all education and training markets such as home, schools, universities, business, and government, but remains far from the model educational experience.
In the early 1970s, few analysts, Alan Turing, Marvin Minsky, John McCarthy and Allen Newell defined a new and ambitious goal for CBI. They thought that computers that could “think” as humans do were just around the corner. Many thought that the main constraint on this goal was the creation of faster, bigger computers. It seemed reasonable to assume that, once we created machines that could think, they could perform any task we associate with human thought, such as instruction.

They adopted the human tutor as their educational model and sought to apply AI techniques to realize this model in “intelligent” CBI. Personal human tutors provide a highly efficient learning environment and have been estimated to increase mean achievement outcomes by as much as two standard deviations [18, 34]. The goal of ITSs would be to engage the students in sustained reasoning activity and to interact with the student based on a deep understanding of the students’ behaviour. If such systems realize even half the impact of human tutors, the payoff for society promised to be substantial.

The ITSs generally provide a high level of guidance and control interactive processes in great detail. Possible navigation decisions by the users are controlled by the system. The programmer has to know in advance what type of user responses are possible and decide what information the system would then present. There is no clear border between adaptive systems and those generally called ITS [Sleeman & Brown (1982)]. The term “Intelligent Tutoring System” was coined to describe these new and evolving systems in the 1980’s to distinguish them from the previous CAI systems. The implicit assumption about the user focuses on “learning-by-doing”.

By the mid-1980’s, ITS began to move out of the AI laboratories into classrooms and other instructional settings and they began to attract
critical reactions. Some shortcomings of ITS became apparent as researchers realized that the problems associated with creating ITS were more intractable than they had originally anticipated. Rosenberg notes that most papers about ITS make few references to the education literature; the majority is grounded in the computing literature.

Chronologically, some ITSs, which have been developed so far, is given in Table 2-1.

<table>
<thead>
<tr>
<th>ITS</th>
<th>Author</th>
<th>Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>SCHOLAR</td>
<td>Carbonell, Collins et al.</td>
<td>1969</td>
</tr>
<tr>
<td>WHY</td>
<td>Collins, Stevens et al.</td>
<td>1977</td>
</tr>
<tr>
<td>BUGGY</td>
<td>Suppes</td>
<td>1981</td>
</tr>
<tr>
<td>SOPHIE</td>
<td>Brown, Burton et al.</td>
<td>1982</td>
</tr>
<tr>
<td>WEST</td>
<td>Brown</td>
<td>1982</td>
</tr>
<tr>
<td>GUIDON</td>
<td>Clancey</td>
<td>1983</td>
</tr>
<tr>
<td>LISP Tutor</td>
<td>Anderson et al.</td>
<td>1984</td>
</tr>
<tr>
<td>MAIS</td>
<td>Tennyson, Park</td>
<td>1987</td>
</tr>
<tr>
<td>OGF</td>
<td>Thepchai, S., Inaba, A., Mitsuru, I., Toyoda, J., Mizoguchi</td>
<td>1999</td>
</tr>
<tr>
<td>ILEX</td>
<td>Cox, R., O'Donnell,M., Oberlander, J.</td>
<td>1999</td>
</tr>
<tr>
<td>ISIS</td>
<td>Meyer, T., Miller, T., Steuck, K., Kretschmer, M.</td>
<td>1999</td>
</tr>
<tr>
<td>PACT</td>
<td>Aleven, V., Koedinger, K. R., Cross, K.</td>
<td>1999</td>
</tr>
<tr>
<td>MethodMan</td>
<td>Crampe</td>
<td>2000</td>
</tr>
<tr>
<td>ActiveMath</td>
<td>Melis, E., Andres, E.</td>
<td>2001</td>
</tr>
<tr>
<td>VisMod</td>
<td>Zapata-Rivera et al.</td>
<td>2004</td>
</tr>
<tr>
<td>DEPTH</td>
<td>Zoran Jeremic, Jelena Jovanovic, Dragan Gasevic</td>
<td>2004</td>
</tr>
</tbody>
</table>

Table 2-1: Some Available ITSs

Innovative intelligent tutoring efforts are well documented in two classic books, [150, 159] and research efforts over the ensuing twenty-five years
have yielded some notable successes in achieving the promise of intelligent tutoring [88, 76]. A major factor contributing to the lack of success of ITS is that the technical difficulties inherent in building student models and facilitating human-like communications have been greatly underestimated by proponents of this approach.

In this chapter, researcher abstracts a set of design recommendations from above extended research effort. The chapter contains three main sections. The first provides research goals related to AI vs. Education. The second section provides a prescription for ITS Educational System design issues for individual, organizational and technological development methods. The third section addresses several issues concerning ITS design principles like intelligent tutoring, intelligent monitoring etc.

2.3 Research Goals: AI vs. Education

There has been a sustained research effort in the application of AI to education over the past twenty-five years with some notable success stories, intelligent tutoring, adaptive learning and learning path adaptation relatively little impact on education and training in the world [10, 151]. There are several reasons for this lack of penetration. ITSs are expensive to develop and until relatively recently, the necessary computing power was expensive to deploy. However, researcher believes that an even more important reason can be traced to the ontogeny of the field and the consequences for software evaluation.

The creative vision of ITSs has largely arisen among AI researchers rather than education specialists [121, 130]. Analysts recognized that ITSs are a rich and important natural environment in which to deploy and improve AI algorithms. Researcher has outlined elsewhere a variety of consequences that derive from this history in AI, [4] but the bottom line is that ITSs are generally evaluated according to AI criteria i.e. the coverage of the systems
in interpreting and responding to student behaviours rather than with respect to a cost/benefit analysis educational effectiveness.

The first ITS program, SCHOLAR [24] developed by J.R.Carbonel (1970) merits special recognition and serves to represent mixed-initiative pattern (i.e. it had two modes of operation: the teacher/tutor could ask the student/learner questions or vice versa) [50, 115, 166]. This program attempted to engage the student through a mixed initiative dialogue on South American geography. The program and student communicated through a sequence of natural language questions and answers.

The tutor could both ask and answer questions and keep track of the ongoing dialogue structure. This tutor was constructed around a semantic network model of domain knowledge. Such network models of conceptual knowledge were revolutionizing human understanding of question answering and inferential reasoning in cognitive science [5, 35] and remain the modal model of conceptual knowledge today [3].

However, the effort to sustain a dialogue revealed the importance of unexplored issues in dialogue structure and pragmatic reasoning. This fed into an interesting research problem and successive dialogue tutors [149, 165] but at the end the fascinating and challenging issues in natural language comprehension took precedence over research in how to deploy dialogue tutors effectively. In fact, SCHOLAR did not attempt to create a coherent conversation.

WHY, Collins, Stevens et al. (1977), is an extension to research on the nature of tutorial dialogs done in SCHOLAR and uses Socratic dialog in an effort to teach learners the ability generalize from experience. It tries to examine the effects of student’s misconceptions.
BUGGY, Suppes (1981), was designed to help instructors to identify underlying misconceptions in student math problems. The tutor presents examples of incorrect math problems (buggy solutions). The system then permits the instructor to generate their own problems for the system to solve in the incorrect manner. From this interaction, instructors attempt to understand the nature of a particular student misconception.

SOPHIE, (SOPHisticated Instructional Environment), Brown, Burton et al. (1982), is an electronic circuit debugging tutor. The system has knowledge of expert problem solving strategies and a rule base to analyze and critique student attempts at solutions. Given a computer simulation of a faulty piece of equipment, students must locate faults by taking appropriate measurements.

WEST, Brown (1982), WEST uses coaching as its pedagogical approach, diagnosing student’s misconceptions as they play a game entitled, “How the West Was Won,” a computer-simulated board game for drill and practice in basic mathematics. WEST critiques students’ decisions as they play, offering suggestions and comments to improve their performance.

GUIDON, Clancey (1983), is an expert instructional program built upon the earlier medical diagnostic program, MYCIN. GUIDON uses a mixed initiative dialog strategy in order to diagnose diseases.

LISP Tutor, Anderson et al. (1984), teaches the programming language LISP using a theory of learning called ACT*. ACT* is a general theory of cognition developed by John Anderson that focuses on memory processes. ACT* identifies procedural and declarative knowledge as part of its definition of expert problem-solving model.
The system functions on the basis of a comparison of student performance to this model of expert performance using the “model-tracing paradigm,” where the system responds to the students’ divergences from the expert problem-solving path with hints directed toward guiding the student back onto the path.

MAIS, Tennyson, Park (1987), The Minnesota Adaptive Instruction System (MAIS) was developed according to the systems approach to instructional design. The MAIS adapts the rate at which students encounter topics using a Bayesian (predictive) statistical model of student progress through the curriculum. The difficulty level of lessons is adjusted according to a prediction of student performance based on a history of performance.

OGF, Thepchai, S., Inaba, A., Mitsuru, I., Toyoda, J., Mizoguchi, T., Opportunistic Group Formation (1999), researchers explored using intelligent agents as individual assistants in a collaborative learning environment. Agents assisted participants in identifying team goals as differentiated from personal goals by providing communication guidance to team process. Results not formally studied.

ILEX (Intelligent Labeling Explorer), Cox, R., O'Donnell, M., Oberlander, J. (1999), Intelligent hypertext online museum repository exploration. Researchers contrasted subject exploration patterns in two modalities: with intelligent system guidance, and without guidance. No significant learning differences noted in comparing these.

ISIS (Instruction in Scientific Inquiry Skills), Meyer, T., Miller, T., Steuck, K., Kretschmer, M. (1999), simulation-based cognitive tutoring system used to teach junior and senior high school students scientific inquiry skills in biology and ecology. System used progressively difficult Skill Instructional Modules (SIMs). Two-years of quasi experimental design
study of effectiveness show that ISIS is more effective than traditional classroom instruction.

PACT, Aleven, V., Koedinger, K. R., Cross, K. (1999), The PAT is Geometry instruction based on Andersonian ACT-R theory of instruction. Researchers investigated value of explanation requirement in student geometry problem-solving as compared with simple right answer approach. Results showed that students providing reasons for their solutions showed a better understanding of geometry principles and were better at applying their knowledge when given new problems.

MethodMan, Crampe (2000), Software Project Management. MethodMan explored user-controlled adaptation versus system-controlled adaptation. Experimentation with user-driven adaptivity proved that user-driven learning is limited by virtue of the learner’s own lack of visibility into what their course of learning should be.

ActiveMath, Melis, E., Andres, E. (2001), is a web-based intelligent tutoring system for mathematics. ActiveMath’ design aims at supporting truly interactive, exploratory learning and assumes the student to be responsible for her learning to some extent. Therefore, a relative freedom for navigating through a course and for learning choices is given and by default, the student model is able to inspect and modify. Moreover, dependencies of learning objects can be inspected in a dictionary to help the student to learn the overall picture of a domain (e.g., analysis) and also the dependencies of subjects.

VisMod, Zapata-Rivera et al. (2004), provides a flexible architecture where students and teachers can create their own views of a student model by choosing nodes they want to inspect from the Bayesian network that represents the student model. In the system the Bayesian network was
divided into three levels. At the top most level the subjects (to be taught) were represented in a hierarchical manner. After that in the second level student’s performance and behaviour were described. Finally the third level nodes represented some analysis on the student’s performance.

DEPTHS (Design Patterns Teaching Help System), Zoran Jeremic, Jelena Jovanovic, Dragan Gasevic (2004), an ITS for learning Design Patterns (DPs), as a part of research in the area of teaching DPs in higher education (Jeremic & Devedzic 2004). The goal was to provide students with the benefits of one-on-one instruction in a cost effective manner. The system was primarily intended for teaching undergraduate students of Computer Science, but it can be equally successful in other education settings, as well.

DEPTHS performs adaptation of the teaching material based on the student performance and the usage tracking data collected during the learning session. The quality of the adaptation provided by the system depends on many factors, such as the accuracy of the diagnostic tools that collect and process data, the student model that is used to store the data and the embedded teaching rules.

While there has been a rich intellectual history in intelligent tutoring, researcher believe that for intelligent tutors to seriously penetrate the ITS, the evaluative focus must begin to shift to educational impact and away from AI sufficiency [57, 123]. This has begun to happen, but at each of the two most recent International Conferences on Intelligent Tutoring Systems [47, 48] only 25% of non invited papers included empirical evaluations.

Among these empirical studies only about one in ten assessed the effectiveness of a computer-based learning environment by comparing learner (student/trainer) performance to other learning environments [45,
Researcher believes that the emphasis on educational impact must permeate all stages of ITS development, deployment and assessment. After twenty five years of ITS development, many important questions raised in effective intelligent tutoring, but only few preliminary answers provided.

In short, researcher devises ITS, that provides individualized instruction tailored to the needs of the individual learners, as many good teachers do. ITSs is the interdisciplinary field that investigates this question by integrating research in Artificial Intelligence, Cognitive Science and Education. Successful ITSs have been deployed to support traditional problem solving activities by tailoring the instruction to the student’s domain knowledge [19, 95]. Despite the changes in technology and in educational focus there is still an ongoing desire for educational and training systems to tailor their interactions to suit the individual learner or group of learners.

In this, researcher will present a variety of research works that illustrate our efforts to extend the scope of intelligent tutors to both support novel forms of pedagogical interactions (e.g., example-based and exploration-based learning) and adapt to student’s traits beyond knowledge (e.g., student’s meta-cognitive abilities and affective states). Researcher will discuss the challenges of this research, the results that researchers have achieved so far and future opportunities.

The proposed research concerns the development of an ITS as Human Knowledge Discovery Agent (HKDA) system to automate the routine teaching-learning support activities and help to monitor and control. System will also provide best possible services to learner (student/trainer), teacher/tutor for learning and improvement in various courses, subjects and topics. Design, development and implementation of cost-effective ITS
2.4 ITS Meets Educational System: Knowledge Management

The rapidly expanding use of ITS in teaching and learning, and the transformed economic basis upon which universities are instituted, have caused universities to transform the ways in which knowledge is produced, stored, disseminated, and authorized [101]. Knowledge is at the heart of much of today’s global economy and managing knowledge has become vital to organizational success.

Knowledge Management (KM) is regarded as one of the effective tool for today’s modern management. In a world of competition, every organization wants to build-up new knowledge, sharing of existing knowledge and creates value from knowledge. The concept of Knowledge Management was evolved by management philosophers in early 40’s and later it has got greater importance because of technological advancement in the field of Information Technology [91].

2.4.1 Knowledge

What is knowledge? Knowledge starts as data-raw facts and numbers—for example, the market value of an institution’s endowment. Information is data put into context—in the same example, the endowment per student at a particular institution. Information is readily captured in documents or in databases; even large amounts are fairly easy to retrieve with modern information technology systems.

Before acting on information, however, we need to take one more step. Only when information is combined with experience and judgment does it become knowledge. Knowledge can be highly subjective and hard to codify.
It includes the insight and wisdom of employees. It may be shared through emailed “best practices” memos or even sticky notes on a cubicle wall. Once we have knowledge, we can put it to work and apply it to decision making.

Knowledge can be classified in many different ways. Domain knowledge, meta knowledge, Commonsense knowledge, Heuristic knowledge, Explicit knowledge, Tacit knowledge, etc. Table 2-2 briefly introduces various types of knowledge.

<table>
<thead>
<tr>
<th>Knowledge Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Domain knowledge</td>
<td>Domain knowledge is valid knowledge for a specified domain. Specialists and experts develop their own domain knowledge and use it for problem solving.</td>
</tr>
<tr>
<td>Meta knowledge</td>
<td>Meta knowledge can be defined as knowledge about knowledge.</td>
</tr>
<tr>
<td>Commonsense knowledge</td>
<td>Commonsense knowledge is a general purpose knowledge expected to be present in every normal human being. Common-sense ideas tend to relate to events within human experience.</td>
</tr>
<tr>
<td>Heuristic knowledge</td>
<td>Heuristic is a specific rule-of-thumb or argument derived from experience.</td>
</tr>
<tr>
<td>Explicit knowledge</td>
<td>Explicit knowledge can be easily expressed in words/numbers and shared in the form of data, scientific formulae, product specifications, manuals, and universal principles. It is more formal and systematic.</td>
</tr>
<tr>
<td>Tacit knowledge</td>
<td>Tacit knowledge is the knowledge stored in subconscious mind of experts and not easy to document. It is highly personal and hard to formalize, and hence difficult to represent formally</td>
</tr>
</tbody>
</table>
in system. Subjective insights, intuitions, emotions, mental models, values and actions are examples of tacit knowledge.

Table 2-2: Types of Knowledge

How does knowledge work in organizations? Knowledge originates in individuals, but it is embodied in teams and organizations. In an organization, examples of explicit knowledge are strategies, methodologies, processes, patents, products, and services. Examples of tacit knowledge in an organizational context are skills and competencies, experiences, relationships within and outside the organization, individual beliefs and values, and ideas.

Knowledge also is embedded in work processes, and it exists in all core functions of an organization as well as in its systems and infrastructure. Effective knowledge management programs identify and leverage the know-how embedded in work, with a focus on how it will be applied. The challenge in knowledge management is to make the right knowledge available to the right people at the right time.

2.4.2 Knowledge Management (KM)

The term “Knowledge Management” (KM) is used to describe everything from the application of new technology to the harnessing of the intellectual capital of an organisation [138]. It is not one single discipline; rather, it is an integration of numerous endeavours and fields of study. J. Rowley (2000) [136] describes the term KM as follows:

“KM is concerned with the exploitation and development of the knowledge assets of an organisation with a view to furthering the organisation’s objectives. The knowledge to be managed includes both explicit,
documented knowledge, and tacit, subjective knowledge. Management entails all of those processes associated with the identification, sharing, and creation of knowledge. This requires systems for the creation and maintenance of knowledge repositories, and to cultivate and facilitate the sharing of knowledge and organisational learning. Organisations that succeed in knowledge management are likely to view knowledge as an asset and to develop organisational norms and values, which support the creation and sharing of knowledge.”

According to B. Gates (2000) [54], “the KM is a very clever term to describe a very simple subject. You manage data, documents and the attempts of the employees. Your goal is to enrich the common work possibilities, including the exchange of thoughts, the usage of successful ideas and the coordination of actions towards the common goal. The management of knowledge must guarantee that the required knowledge will reach certain people at certain time, so that people can take certain actions.”

In brief, KM is the management of processes that govern the creation, dissemination, and utilisation of knowledge by merging technologies, organisational structures and people to create the most effective learning, problem solving, and decision-making in an organisation.

In order to reap the benefits of KM, the two major aspects of community and collaboration will have to be put into practice:

Community: Community is a group of people bound together by certain mutual concerns, interests, activities, and institutions. From KM perspectives, the subject of communities is essential because knowledge in an organisation is often built up and generated by small, informal, self-organising network of practitioners [141]. In addition, the current advances in Information and Communication Technologies (ICT) also
create new forms of setting in which people can communicate to productive knowledge create and share their knowledge across both geographical and temporal boundaries.

Collaboration: Most organisations realise that they will improve performance if their staff work together. Collaboration is one of the most critical issues in educational context, especially in online distance education where people and knowledge are distributed across time and space. KM practitioners apply many different approaches to develop the type of culture that builds the desire for teamwork and a collaborative working [141].

A number of studies in education have examined the relationship between collaboration and learning [40]. According to [32], collaboration is a way of overcoming two major problems in distance learning: the problem of accommodating to the academic discourse and the problem of becoming part of the academic community living at a distance.

2.4.3 Knowledge Management Continuum

The practices of KM can provide a framework for understanding how and where focuses for educational outcome, given the goal and mission of the organization. In this process, the data-information-knowledge continuum provides an iterative cycle that continually connects back to and help people focus on outcomes (see Figure 2.1).
Due to the quantitative data, wealth of information, the knowledge explosion, and the rapid development of ICT at the start of the twenty-first century, it is essential to handle complex information and knowledge intelligently and responsibly. Therefore, it is necessary to manage knowledge at an individual as well as an Institutional level.

A modern Institution’s must solve the tasks of their region and the country’s economy tasks. That is why today it is necessary to speak about a new role of Institution’s in informational society, which requires a new attitude towards the management of knowledge and the system of KM. Today this is one of the most promising and quickly developing tendencies, which raise the competitiveness of higher education in this specific market.

In most cases an Institution’s involvement with KM is not the end in itself but connected to specific goals, that can be deduced from the Institution’s super ordinate goals, either directly or indirectly. In other words, to be economically justifiable, KM has to contribute added value to the Institution’s efforts to meet its overacting goals. This “value added” must be specific and measurable in relationship to Institutional goals and their achievement.
2.5 Knowledge Management in the Institution

The growing importance of KM does not spare any field. Its success is being felt in corporate business and industry. Now there is a need to apply KM techniques in Higher Educational Programs as vital as it is in the corporate sector. Worldwide, the higher education programs are heading towards an application-oriented educational pattern. The countries that are able to adopt applied educational programs have succeeded in managing Human Resource in an optimum way and it can lead to better decision-making capabilities, reduced “product” development cycle time (for example, curriculum development and research), improved academic and administrative services, and reduced costs.

Consider the number of faculty/teacher and staff who possess institutional knowledge. For example, what institution does not have a faculty/teacher member who has led successful curriculum revision task forces? Or a departmental secretary who knows how to navigate the complex proposal development or procurement processes? Or a researcher who has informal connections to the National Science Foundation? Or a special assistant to the president who has uncovered (or generated) useful reports that individual deans or department chairs could use to develop their own strategic plans?

With the goal of KM to develop the potential for learning of individuals and Institutions by developing, exchanging, and using knowledge, KM can be seen as a prerequisite for innovations in Institutions.

The recognition of the importance of intellectual resources in modern world proves the appearance of new management branches, concentrating attention to one subject-knowledge. The management of knowledge unites into one different part of any organization-processes, people, and
technology. Knowledge is that basement on which the competitive advantages of the company are being built.

Informational society, now already knowledge society tries to learn how to use knowledge in order to achieve interests and manage the streams of information. Institutions during the period of industrial society performed the role of preparation centers of the specialists for the economy. Informational society has changed the status of higher education schools.

Knowledge society influenced the creation of new type schools-innovation schools. Nowadays a institution is a center of science and innovations development, where continuous learning, or lifelong learning is taking place. In institutions the system of professional studies, professional change of qualification and qualification improvement system,

In this context, KM is often regarded as a subject and instrument for the realization of the metaphor of the learning Institution. Subjects regarding the learning Institution emphasize almost the same goals as KM; but in actuality KM can be regarded as a prerequisite for the creation and maintenance of a learning Institution. If an organization (Company, School, Institute, University etc.) is able to handle its knowledge resources well, it can react to shifts in the marketplace faster and more flexibly.

Thus it demonstrates its capability to learn. The learning ability of students/learners provides a major competitive advantage in the framework of the increasing educational and industrial demand. In this context, individual and team-based learning are as important as the documentation and distribution of knowledge within an Institution.
2.6 Knowledge Management and Communities of Practice

The individual as the initial point of KM has been neglected, especially as KM has become an important topic in the global educational knowledge sharing world. Most Institutions at first relied on technology-based KM, which has mostly led to the implementation of databases.

On the basis of an intensive analysis of the subject of KM, the conclusion can be drawn that most attempts to manage the resource of knowledge have failed. Today it is clear that KM approaches can only be successful if the individual plays a major role in the process. But it is the individual acting as a member of a community that is critical. The term ‘communities of practice’ was first coined by Etienne Wenger and Jean Lave (1991).

Academicians, technologists, and management professionals have discussed about knowledge and communities over ten years, both from theoretical and practical perspective. According to Wenger (1998), a community of practice is a community in which the members are informally bound by what they do together and by what they have learned through mutual engagement in these activities.

Communities are highly self-organized, and it is the responsibility of the members to control the community and distribute the work among its members. Thus self-management, communication skills, the capacity for teamwork and the handling of knowledge are valuable skills for the members of communities. These individual KM competencies are not only important in the range of communities but also for life in a knowledge society. To be able to cope with the new challenges of a knowledge society, these skills become core competencies of every individual.

Thinking of social institutions as the gardeners of learning, as charged with the responsibility of developing, sustaining, organizing, and nurturing
societally valued configurations of competencies revitalizes notions such as corporation, organization, management, vision, or strategy.

But even those who speak about “learning organizations,” “life-long learning,” or the “information society” do so mostly in terms of individual learners and information processes. The notion of community of practice breaks out of this mold; it provides a new way of dealing with the complex issue of creative learning in organizations; and it opens new fields for strategic and visionary thinking.

There is much to share and much to explore. Consider this as an invitation, those who can understand learning as a social phenomenon and can translate this understanding into learning organizations will be the architects of tomorrow.

2.7 Knowledge Management in Formal Education

One of the most important challenges faced by most of the developing and the underdeveloped countries is the spread of education among all. As an example, in India the literacy rate was about 65.38% and in the state of Gujarat it was 69.97% in 2001 [90]. A plausible reason behind this low literacy rate is attributed to the need of proper schools, proper infrastructure and poor teacher to student ratio [41].

It is the task of Institutions and Universities to provide students/learners with basic KM skills needed for life in a rapidly changing society. However, the traditional system of Institutions and Universities does not meet the requirements of a knowledge society. Institutions and Universities should be transformed into learning organizations where KM comes to life.

The core aim should be the mediation of deep understanding of subjects as well as topics and the development of individual KM skills. This new
orientation requires a holistic change process at all levels of academic Institutions. In educational system, the analogy of communities of practice is learning communities.

Learning communities offer multifaceted possibilities for the integration of KM processes in Institutions and Universities. Communities can be developed among the learners within the academic Institutes. Thus long-term and deep engagement with a subject as well as topics, interdisciplinary learning, and the development of social skills can be facilitated.

At the same time, the exchange of knowledge between the teachers/tutors can be stimulated by implementing communities among teachers/tutors. In this context, the initiation of a community that reaches out over the academic Institutions boundaries can further enhance this process of knowledge sharing and mutual learning.

2.8 Knowledge Management in Information & Technology

IT is technology offering new ways for communicating and exchanging information and knowledge. Greater understanding of existing knowledge systems—how information is gathered, stored, shared, concretized and evaluated amongst stakeholders will aid the appropriate application of IT. Accommodating all sectors of society particularly rural communities in the transition from traditional through to new learning societies is an urgent issue for policy makers.

The impacts and effects of new IT on development are not clear and it will take more time for the economic and social effects of IT inventions to be evaluated [127]. There is a vast literature on the benefits and potentials of IT as tools for enhancing people’s daily lives whether by increasing access
to information relevant to their economic livelihood, better access to other information sources; healthcare, transport or distance learning.

In this context, the question arises of how the implementation of KM processes to academic Institutions can be facilitated. Within the field of KM, research activities are still limited primarily to case studies. On the basis of several case studies with focus on small and medium-sized academic Institutes, six critical success factors for the implementation of KM processes have been found. These factors can also be applied to different kinds of organizations (schools, Institutions, Universities, etc.).

**Academic Culture:**
Successful implementation of KM is closely related to the academic culture. However, these cultural changes need time. In the context of the implementation of KM activities, it is important to know how KM initiatives interact with the culture and to determine how the culture should be changed.

**Qualification of Teachers/Tutors:**
The competencies and motivation of teachers/tutors strongly influence the success of KM. Thus human resource development and the design of incentive-systems are highly important.

**Learning Culture:**
The implementation of KM can be seen as a step-by-step learning process which has to be nurtured.

**Management Support:**
KM activities only have the opportunity to be successful if they are supported by the executive board.

**Integration of Knowledge Processes to Academic Institution’s Processes:**

It is important to connect KM closely to the academic Institution’s processes in order to gain acceptance and for reasons of economical legitimacy.

**New Information and Communication Technologies:**

The implementation of KM does not necessarily have to be connected to an investment in new information and communication technologies. The potential for such technologies evolves only if the cultural and academic Institutional conditions exist.

To confirm and empirically verify these findings, research initiatives on KM should be designed to be interdisciplinary and extremely precise. Furthermore they should be based on a wide range of methods.

2.9 Intelligent Tutoring

Intelligent tutoring is a knowledge-intensive activity. ITS have shown themselves to be effective in practice Anderson et al., [82] Mitrovic et al., [103]. They are, however, extremely resource intensive to build, requiring detailed knowledge about instructional technology in general, the paradigm in use in particular, and a high-level of software development expertise. In an attempt to make development of ITS easier, tutor authoring tools or shells have been developed Murray [111].

Intelligent tutoring is concerned with simulating the tutor to guide the learner (student/trainer) in solving subsequent problems. This is in addition to discovering and diagnosing the learners’ bugs and mistakes.
The application domains that are categorized under this technology are (i) Curriculum Sequencing, (ii) Interactive Problem Solving Support, and (iii) Intelligent Solution Analysis.

(i) Curriculum Sequencing (Pedagogical Strategy):
Curriculum Sequencing is used to guide the learner to find the optimal path through learning material. It determines the sequence of knowledge units or objects to learn, and the sequence of tasks (examples, questions, problems) to present to the learner. ELM-ART tutor [43] and KBS-Hyperbook [63] are two systems that apply curriculum sequencing. These systems present students with a textbook style curriculum along with a reference manual. A set of similarity links, exist between the textbook and the various subjects in the reference manual in both directions.

(ii) Interactive Problem Solving Support:
Systems using this type of technology guide the learner (student/trainer) while he is solving a problem. This can be achieved by either providing a hint to execute the next step, or by choosing and presenting more relevant examples. ActiveMath [98] and ELM-ART tutor are examples of applying interactive problem solving support technologies. ActiveMath is a web-based intelligent tutoring system for mathematics. These systems strive for improving distance learning. Moreover, they use proprietary knowledge representation formats rather than a standardized knowledge representation which is exchangeable between systems. Some user-adaptivity is offered by systems such as ELM-ART [160] and Metalink [112].

(iii) Intelligent Solution Analysis:
The major role of this web based ITS technology is concerned with analyzing the learner's solution to any given problem. The student model
is updated if the final answer is either correct or wrong. If the solution is correct, the system infers the appropriate knowledge. On the other hand, if the solution is wrong, it analyzes the answer and determines the nature of error. The system tries to identify the incorrect knowledge stipple responsible for this error (knowledge diagnosis). German Tutor [130] and ELM-ART tutor are among the systems that apply Intelligent Solution Analysis. In these systems, students can exercise interactively and study work examples. In some cases, it is impossible to determine the solution path a student has chosen just by looking at the (correct) result. Therefore, the attribution to the correct competency is hard to determine.

Intelligent Solution Analysis technology is used in building and updating the learner student model. The literature generally divides the student model into overlay and buggy models.

The Overlay Model is based on the assumption that the learner knowledge is a subset of expert knowledge. This model stores historical data about the knowledge the learner has mastered. This data is very useful in some technologies like curriculum sequence and adaptive navigation support.

The buggy model considers the learners’ knowledge as a perturbation of the expert’s knowledge. This model contains a list of predefined misconceptions (bugs) describing errors observed by the learner. This model is the foundation of Intelligent Solution Analysis.

2.10 Intelligent Monitoring

Intelligent Monitoring technology is based on the ability to compare records of different learners. In this comparison, mismatched entries are identified. The goal is to identify the learners who have learning records different from those of their peers. This applies to both troubled learners, who need more help or bright learners, who need larger challenges.
Intelligent class monitoring systems use AI techniques (mainly data mining and machine learning) to select the different learners who need more attention. They also infer the learning material segments that are too easy, too hard or confusing. Logic ITA [167] is an example for systems using intelligent monitoring. Romero [134] also demonstrates genetic algorithms for data mining technique in context of intelligent monitoring.

Systems in this area can be classified into two categories. The first focuses on the application of data mining techniques (especially association rules) on hypermedia systems to discover the relationships between the learner’s knowledge level and the difficulty level of the presented subject. The designer uses the discovered relations to reconstruct the learning material to be more effective [20, 134]. The second category applies different data mining techniques on systems that perform learner diagnosis for bugs, and can infer the subjects responsible on these bugs [99, 100, 167].

The bugs and the subjects are the main features used in clustering techniques to organize the learners into clusters. The teacher/tutor can see these clusters, and hence provide more attention to certain clusters which has more mistakes. In addition, the same data and the learner marks are used in classification techniques to predict the final learner grade.

Association rules have been used to determine the relationships between mistakes and subjects, and mistakes and each other. This information can be used to predict the sequence of bugs, and learning material developers could incorporate this information to give proactive feedback to learners.
2.11 Conclusion

In this chapter, researcher review the history of ITS and discuss their development in the context of AI and educational knowledge management theory. Very recently, AI community have performed the majority of work on ITS with little interaction with educational researchers. A number of developments in both AI and educational systems have caused many to forsake ITS. Some consider them as an embarrassing reminder of the naive enthusiasm both disciplines had, preferring to concentrate on issues such as the use of standard computer software as cognitive tools in the classroom. Others suspect that ITS advocates want to replace teachers. However, it may be premature to dismiss ITS as an educational dead end.