An evaluation of e-Learning for the undergraduates in Xi’an Jiaotong University

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STATEMENT OF AUTHORSHIP

Except where reference is made in the text of this dissertation, this dissertation contains no material published elsewhere or extracted in whole or in part from a dissertation presented by me for another degree or diploma.

No other person’s work has been used without due acknowledgement in the main text of the dissertation.

This dissertation has not been submitted for the award of any other degree or diploma in any other tertiary institution.

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Abstract

In recent years, tertiary institutions in developed countries have made extensive use of Course Management Systems (CMSs), software packages designed to help educators create online learning communities. To date, however, such packages have been little used in institutes of higher education in China. In this paper, we describe the implementation of an e-learning project on a campus in China and seek to determine the benefits, if any, of using e-Learning systems such as CMSs, while implementing a novel approach to the delivery of an IT course, Student Centered Teaching with e-Learning (SCeT).
1. Introduction

1.1 Overview

The demand for higher education has grown and will probably grow further over the next decades throughout the world. Once statistics of the UNESCO showed that enrollment in tertiary education would increased nearly fourteen fold from 40 million in 1950 to more than 400 million in 2000 [Yip 1982].

It is also true in China that higher education has played an important role in the economic construction, science progress and social development by bringing up large scale of advanced talents and experts for the construction of socialist modernization.

The Higher education scale is increasing at a very high speed, the Annual student admission, and the instructors increased 3.14 (108.36 to 4.4734 millions) and 1.1 (0.4072 to 0.8584 million) times respectively during 1998 to 2004[MoE 1998-2004]. See Figure 1.

![Figure 1 Chinese higher education trends](image)

Two trends are obvious in Figure 1 that the teacher and student ratio becomes larger than ever before and more than half the faculty members are those who joined the faculty since the Chinese Higher Education Institutes (HEIs) expand began at 1998. The direct result is the decline of the HEI’s education quality [Zhou ji 2005].
Around the world, one recent widely advocated and applied approach to this problem of a mismatch between huge demand for higher education and the resources to satisfy it has been the application of new educational technologies [Bates 2000, Hazemi et al 1998]. In particular, there has been the attempt to save time and money by replacing face-to-face educational scenarios with e-Learning and IT applications [Anderson 2000]. Superficially, this means that paper- and blackboard-based materials have migrated to new Internet and intranet-supported media. More substantially, the new methods of delivery have created a wide variety of new and potentially highly enabling learner-centered learning paradigms [Julia & Peter 2002]. These technologies and paradigms are even today novel everywhere in the world, but in China they are particularly new and their successful integration with established educational practices and institutions may require sometimes painful adjustments for students, teachers and administrators.

To understand the Modern HEIs in China, and the e-Learning as a means to improve the education quality for them, we should make some SWOT analysis to the situation that our education system faced.

1.2 The SWOT analysis of the Chinese higher education

1.2.1 Strength

1. Sturdy higher education accommodation demand:

The Chinese higher education admission rate has achieved 19% [MoE 2004] in 2004, comparing the rate of the 1998’s 6%, increased 13 percentage points and that is achieved within 6 years. This change has significant means, the data show that the Chinese higher education to have risen above the threshold of "mass" higher education status of the nations (the admission rate achieve 15% and above). But, if compare with Canada, the United States, Australia, Finland, New Zealand, Norway and Korea (the grass admission exceed 50%) [Zhang li 2001], the Chinese higher education still has enormous development space.

2. Chinese traditional education notion:

Valuing the education is a Chinese tradition. And in the modern Chinese society,
the parents are paying too much on their children’s education, especially in the higher education period. Chinese Social Science Research Institute research fellow Li peiling said, "In recent few years, many investigate project that concerning city resident’s purpose of save money, the top one always the education expenditure for their children, exceed to retire and housing expenditure, this is not a very normal affair. [Liu 2005]"

3. Economic development in China provides many job opportunities:

   Chinese economic development provides most of job opportunities for the graduates of the Chinese HEIs in next 10-15 years. It is said that “In China, domestic and multinational companies serving the fast-growing domestic market already provide attractive opportunities for suitable graduates, and there are many more jobs in the manufacturing export sector.” [McKinsey 2005] and ” We estimate that given the global aspirations of many Chinese companies, over the next 10 to 15 years they will need 75,000 leaders who can work effectively in global environments; today they have only 3,000 to 5,000.” [McKinsey 2005]

1.2.2 Weakness

1. Most of the Leading HEIs in China (especially some of research universities) emphasize and reward research outcome more than effective teaching:

   Of course this is not only in China, but the same is true in some of the developed countries. Because the main promotion mechanism encourages the instructor to do academic research and publish papers in the academic journals, so the instructors, especially the high ranked professors, are not willing to stand in the classroom to do the face to face teaching. From the statistics, we can get the impression that the student and instructor ratio has achieved 16.22:1[MoE 2004], which is quite fair to compare that with most of the developed countries. In the real situation, most of the students in Chinese HEIs have to attend most of their courses in the big classroom in which might be over 150 students there. And during the course proceeding, excluding the weekly Q&A (question & answer) time, the student can hardly rely on the instructor. It is not like western universities, the TA (Teaching Assistant) system is not a routine in the most of the Chinese HEIs.
2. Most of the HEI instructors emphasize on theory rather than practice:

   It is a problem that there is a big difference of Chinese HEIs with the western counterpart, “the educational system’s bias toward theory. Compared with engineering graduates in Europe and North America, who work in teams to achieve practical solutions, Chinese students get little practical experience in projects or teamwork. [McKinsey 2005]”

3. Most of the HEIs in China aim and encourage students to get higher scores in the education process with little evaluation on whether students could use the learned knowledge:

   Because of the impact of centralized admission examination in China, most of the undergraduates in Chinese HEIs are accustomed with "learning for exam", most of higher school students like to study the abstract note from teacher, hoping to get a good mark in the exam; but fail to plan their personal career and knowledge construction.

4. The negative influence of one-child policy in China brings:

   Because of the policy, China now already has accumulated the total amount of 90,000,000 such youngsters. It becomes a big problem for China higher education on how to educate this young generation, e.g. how to educate them effectively and make them cooperates with others properly still is a special problem for the Chinese higher education.

5. Because of the historical reasons, the Chinese HEIs pedagogy is relatively simple and monopoly to that of western countries:

   The teacher is “the absolute center” in the classroom, the communication between the educator and student and the feedback about the teaching result from students are not encouraged.

1.2.3 Opportunity

1. The Chinese reform and open policy that brings opportunity, personal and academic exchange that bring the fresh air to the Chinese HEIs:

   The Internet, the text books from abroad, the faculties educated abroad bring in
new education content and some kind of changes in the teaching.

2. The Internet brings the variety of information and education opportunity:

Having got all the universalities in Chinese in the net, the China education rears the network (CERNET) which becomes one of the biggest Chinese BSPs. Most of HEIs have established their websites and the students can access the Internet in their dormitory via the campus network. All kinds of teaching resources are available on the net, which provide the possibility for independent study for the students themselves.

3. The MoE of China regards Internet and public learning resource as the strategic assets:

Hundreds of “elite courses” that evaluated by the committee organized by MoE from various HEIs have been promoted to be shared all over the country [http://www.jpkcnet.com/greatcourse/].

1.2.4 Threat

1. Lacking enough qualified instructors will become the bottleneck for the developing Chinese higher education:

As mentioned above, over half of the faculty members entered the HEIs after 1998, lack of the experience and proper training. It becomes a negative factor to improve the higher education quality. As a result, multinational companies find out that few Chinese HEIs graduates have the necessary skills for service occupations. Fewer than 10 percent of candidates, on average, would be suitable for work in a foreign company in the nine occupations studied: engineers, finance workers, accountants, quantitative analysts, generalists, life science researchers, doctors, nurses, and support staff [McKinsey 2005].

2. The traditional Chinese education is in conflict with western new education notions:

Most of nowadays HEI instructors were/are educated in "teacher centered" system and impacted by the Chinese traditional " teacher a dignity(师道尊严)" concept, thus it will be very difficult for them to comprehend and accept teaching principle of modern western university’s, for example: Cognitivism, Constructivism
and doctrine with the "student centered learning" etc.

3. Education development opportunity might lose:

Since it is increasingly well-recognized in western countries that the adoption of e-Learning represents one of the most important phenomena in the development of higher education institutions [COM 2002], the use of ICT (Information and Communication Technology) is seen as "the single most important change driver in education and training systems" [COM 2002], alongside being an opportunity for universities to modernize and answer the social and political pressure towards wider access to higher education and lifelong learning. Thus, there is a large body of official documents that stress the importance of developing coherent strategies for introducing e-Learning in higher education and propose measures in this direction [COM 2001]. But the attitude of misty perception of the Chinese HEIs to the e-Learning may hamper this education development opportunity. Form our experience and knowledge, it is observed that the e-Learning is mostly used in network college (for continue and adults education) and networked high school education in China; but in campus universities, despite of the fact that most of the HEIs in China have their campus intranet and Internet access, the e-Learning means namely limited in distributing resources such as applications, course content, or assignment deliver site etc. In a kind of infantile state, there is no technical support, no routine or unified process regulation, and no formal management. Especially, the extensively used CMS (Course Management System) in western universities is rarely seen in China’s. e-Learning development is very fast, although network condition in China and its HEIs is not bad compared with the counterparts of the most of the developing countries, a majority decision makers are not sure about its influence to the campus student’s education quality, just relate it with remote education. This kind of circumstance will cause the lost of opportunity of improving higher education in China, and affect China development process from the manufacturing to service economy development [McKinsey 2005].
1.3 Aims and objectives of the dissertation

This dissertation aims to develop a prototype of didactics combined with e-Learning as an important assistance means to be used in the Chinese campus university and the evaluation method to approve its effects. The prototype of didactics emphasizes on enhancing the teaching efficiency and solving the problems which are mentioned above and extensively existing in the Chinese HEIs.

The second aim to achieve is to do a pilot experiment to use e-Learning in the university that I am working for---The Xi’an Jiaotong University to search how far the e-Learning can go when it is used in the real HEI course, it shall provide the beneficial experiences both for the instructors and the students in the Chinese HEIs.

In this dissertation, some real e-Learning system as well as real HEI course instructors and students are used or participated in the real teaching and learning processes. Some experience and the evaluating results might be not only interesting and fresh, but also instructional, especially to the instructor and university decision makers.

1.4 Scope

This dissertation has the following aspects:

1. How to realize and analyses the weaknesses of Chinese higher education:
   • What are the differences of Chinese HEIs from those of other countries’?
   • What is the negative side of the Chinese tradition that may affect the Chinese youth from catching up the education or learning developing trends?

2. How to improve the HEIs (especially the research universities like Xi’an Jiaotong Univ.)’s on campus education quality using e-Learning as assistant means:
   • What is the situation like the most China HEIs to use the IT for the education process?
   • What is the difference compared with developed country’s universities in using IT in the education process?

3. How will the IT or e-Learning be involved in suitable pedagogy for the new generation
students;

- what is the main stream pedagogy used in the Chins HEIs?
- What is the main stream pedagogies used in the developed country’s universities?
- what are the suitable pedagogy/ pedagogies that can combine e-Learning and achieve a satisfactory result?

4. Some pilot experiments (As the dissertation began to write, the Blackboard might be introduced in our university next semester, and I have used Moodle, the course management system in my courses for three semesters), which had been carried out in my MIS course and we can ask:

- What are the main benefits gained from the e-Learning?
- What is the main incentive to promote e-Learning?
- What is the main hurdle against adoption e-Learning?
- How to evaluate the result of e-Learning?
- What and how the course(s) can be adapted in the prototype of didactics?

So, this dissertation is from SOCIOTECHNICAL PERSPECTIVE, to explore how the e-Learning especially the CMS could be adapted as a measure to improve the IT education in Chinese regular HEIs.

2. Background study

2.1 e-Learning: definition, models and strategies

2.1.1 e-Learning: definition

One particularly interesting fact of this development is that e-Learning solutions were almost exclusively driven by companies and corporate institutions. Definitions or articles on e-Learning are rather new, meaning that which are looked at a term that exists merely since 1999. That was the time when companies offering computer based training established so-called e-Learning solutions - e.g. one of the largest companies in this business field, "CBT systems" renamed itself "Smartforce" in 1999, introducing the trademark "The e-Learning Company" [Smartforce 2000].
Since then definitions and understanding of e-Learning have evolved different, some typical ones are listed in following:

- **Definition one:** In a nutshell, e-Learning is a special kind of “technology-based learning” [Anderson 2000b].

- **Definition two:** Comprehensively, e-Learning can be defined as "the delivery of content via all electronic media, including the Internet, intranets, extranets, satellite broadcast, audio/video tape, interactive TV and CD-ROM" [Urdan et al 2000].

- **Definition three:** Some companies in the market, e.g. Saba [Saba 2000] or Cisco Systems [Cisco 2001] define the e-Learning as a pure online learning.

- **Definition four:** In this dissertation, e-Learning is defined as “e-Learning is supported or enabled by information and communication technology [ICT].” [Julia G.& Peter M. 2002]

In the context of this dissertation, the definition four is adapted as our guide and e-learning will be considered to describe learning that utilizes information communications technology to promote educational interaction between students, lecturers and learning communities [Holley 2002].

### 2.1.2 e-Learning: strategies

One particularly interesting fact of this development is that e-Learning solutions were almost exclusively driven by companies and corporate institutions. Companies detected this form of learning as a possibility to train their employees in shorter time and with less financial effort [Julia G.& Peter M. 2002]. In contrast to e-Learning business ventures, universities are not overtly profit-oriented and therefore the pace of adoption of e-Learning has been slower than in the business world [Collis & Moonen 2001].

**Strategic target for university to develop e-Learning**

Academic institutions have invested in e-Learning as it seems to offer possible solutions for three immediate strategic targets, namely:

- Increasing or sustaining the quality of educational programs and consequently the quality of graduates;
- Improving access to learning opportunities;
• Reducing the total cost of education.

**The e-Learning strategic planning process**

**The first step:** to fully analyze the current situation as it pertains to the ability to launch and sustain e-Learning. This information is used to describe a desired situation, in other words to produce a vision statement. The statement is not about how many online courses should be offered or what technology should be used, but rather about how the university, faculty or department will be recognized and valued internally and through the eyes of learners.

**The second step:** to generate a mission statement to shape the actions needed to achieve the vision.

**The third step:** a series of analyses (external and internal environments, benchmarking and gap analyses) using different models. Traditional business models such as Michael Porter’s five forces model could be used to identify possible threats in a specific market or a SWOT analysis could be used to determine strengths, weaknesses, opportunities and threats that the university or higher education sector might posses or face. New e-Learning models are continually emerging as new research findings become available. E-Learning models are attempts to develop frameworks to address the concerns of the learner and the challenges presented by the technology that is required to implement online learning effectively. In the strategic planning process these models are useful for evaluating e-Learning programs and determining critical success factors.

**The fourth step:** On the basis of the analyses, specific strategic recommendation can be made and a plan of action implemented to achieve the vision.

**The fifth step:** Organizations have to evaluate their strategies and review their strategic plans periodically to adapt to emergent strategies and evolving changes [Rosenberg 2001, Lerner 1999].

**2.1.3 e-Learning: models**

"Learning" in the academic world emphasizes broad foundational knowledge, theory and analytical skills. e-Learning may be used to supplement either traditional contact education or print-based distance education or it may be a complete replacement of the traditional
modes [Elmarie 2003].

A good learning experience is one in which a student can "...master new knowledge and skills, critically examine assumptions and beliefs, and engage in an invigorating, collaborative quest for wisdom and personal, holistic development" [Eastmond & Ziegahn, cited by Jonassen et al 1995]. The most valuable activity in a classroom of any kind is the opportunity for learners to work and interact together and to build and become part of a community of scholars and practitioners [Jonassen et al 1995].

E-Learning models have evolved from classroom replication towards models that integrate technology and pedagogical issues. The early e-Learning model, the focus was primarily on the use of technology to create convenient virtual learning environments for learners to access anywhere, any time. The learning design (content development) and the training of educators and learners for online teaching and learning received less attention.

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![Image of the demand-driven learning model](MacDonald et al 2001)

Figure 2 The demand-driven learning model [MacDonald et al 2001]

The demand-driven learning model (Figure 2) was developed in Canada as a collaborative effort between academics and experts from private and public industries [MacDonald et al 2001]. Although this model is based on the system vendors’ model of technology, content and service, the technology is seen as support or a tool to achieve the desired learning outcomes in a cost-effective way. More recent models focus on pedagogical
issues such as online instructional design and the creation of online learning communities [Motschnig-Pitrik 2002]. The e-Learning models reviewed in this dissertation illustrate this evolution.

**Content, service and technology model**

In the growth and experimentation phase of e-Learning in the 1990s, universities, public and corporate institutions, incited by technology learning management system vendors, based their e-Learning initiatives on an e-Learning model comprising three elements: service to the customer (learner as well as instructor), content and technology. Owing to the continuous ICT developments, the focus was primarily on the use of technology to create convenient virtual learning environments for learners to access anywhere, any time. any educators and technology vendors assumed that the delivery of traditional learning content via the Internet constitutes e-Learning [Engelbrecht, E 2003].

The primary purpose of the model is to encourage academics to take a proactive role in the development and use of technology in the teaching process. It emphasizes the three consumer demands: high quality content, delivery and service. Content should be comprehensive, authentic and researched. Delivery is web-based and the interface of e-Learning programs should be user-friendly with communication tools to support interactivity. Service should include the provision of resources needed for learning as well as any administrative and technical support needed [MacDonald et al 2001].

As technology is fundamental to e-Learning, this model provides a valuable framework for understanding the importance of investing in ICT infrastructure to support content, delivery and service. However, this model also highlights the importance of realizing the changing needs of learners and their employers and the pedagogical changes that must be made to content and services to meet these needs.

**Instructional design models**

One of the most crucial prerequisites for successful implementation of e-Learning is the need for careful consideration of the underlying pedagogy, or how learning takes place online [Conrad 2000]. Instructional value is added by:

- Customizing content for the needs of the learners
● Presenting outcomes-based learning objectives
● Logically sequencing material to reinforce those objectives
● Basing navigational options (hypertext links) on existing and desired skills and knowledge of learners
● Designing objective-based, interactive learning activities that learners must complete to receive some form of evaluation.

Instructional design models for e-Learning based on the processes of designing, developing and delivering curriculum material are usually closely aligned with traditional classroom learning models that specify some combination of planning, implementing and evaluation to organize and present curriculum content. So, it is the first choice for us to implement the pilot experiment on e-Learning in our MIS course in Xi’an Jiaotong University.

The instructional design models provide valuable frameworks for those responsible for developing e-Learning materials. These models are valuable for strategic planning, because they emphasize the issue of quality; quality of learning materials and quality of learning support.

**Learning communities**

Interaction in all its forms (between and among learners, learners and educators, learners and information or content) is an essential element in the learning process [Laurrillard 2000]. But, while educators could design their learning materials according to an appropriate instructional design model, the learners may not participate in the learning experience as expected.

The community of inquiry model developed by Garrison and Anderson is an attempt to give educators an in-depth understanding of the characteristics of e-Learning and direction and guidance to facilitate critical discourse and higher-order learning through the use of e-Learning. According to the authors, "institutions of higher education have slowly begun to appreciate that the content of an educational experience alone will not define quality learning but that the context – how teachers design that experience, and the interactions that drive the learning transaction – will ultimately distinguish each institution" [Garrison & Anderson 2003].
A community of inquiry provides the environment in which learners can take responsibility for and control of their learning through interaction and is a requisite for higher-order learning. Given the information access and communication facilities of the Internet, an e-Learning environment has distinct advantages as a means of providing support to communities of inquiry to promote higher-order learning.

The community of inquiry model (Figure 3) has three key elements that must be considered when planning and delivering an e-Learning experience. They are cognitive presence, social presence and teaching presence.

- **Cognitive presence**
  
  The authors see cognitive presence "as the extent to which learners are able to construct and confirm meaning through sustained reflection and discourse in a critical community of inquiry. In essence, cognitive presence is a condition of higher-order thinking and learning".

- **Social presence**
  
  Social presence is defined as "the ability of participants in a community of inquiry to project themselves socially and emotionally, as 'real' people (i.e. their full personality), through the medium of communication being used".

- **Teaching presence**
  
  Teaching presence is defined as "the design, facilitation and direction of cognitive and social processes for the purpose of realizing personally meaningful and educationally worthwhile learning outcomes".

![Community of Inquire Model](image)

Figure 3  Community of Inquire Model [Garrison & Anderson 2003]

The community of inquiry e-Learning model builds on the demand-driven model and the instructional design models and draws attention to the complexities of communication in
a virtual learning environment. Even in higher education today, the reality is that the concept of communities of inquiry that encourages learners to approach learning in a critical manner and process information in a deep and meaningful way has not been widely established. While this model may seem idealistic, the issue of interaction in the learning process has to be addressed [Garrison & Anderson 2003].

2.2 The theories of learning and didactic methods

Every didactic method builds upon a theory of learning. Currently, individual approaches tend to be categorized under three mainstreams [Holzinger 2002]:

2.2.1 Behaviorism

Behaviorism deals with perceptible data and excludes ideas, emotions, and inner experience. Learning is seen as a pure stimulus-reaction mechanism being based on conditioning. Although pure behaviorism is often criticized, its various forms still prove effective for the acquisition of factual knowledge. This applies despite the fact that human beings play the role of passive "knowledge receptacles" [Skinner 1974].

2.2.2 Cognitivism

Cognitivism defines learning as a procedure of information processing in the human brain, with a close connection to artificial intelligence. The goal is concept learning and problem solving. Teachers are no longer strictly experts but act as tutors who accompany the learners during the learning process and support them in active problem solving. The target of learning is the detection of a problem solving process (How can I find the solution?) rather than the recall of factual knowledge. In this mainstream, the cognitive aspects of the individual are considered, but his or her relationship to the world including other people is not an issue.

2.2.3 Constructivism

Constructivism is rooted in learning theories and principles advanced by Dewey, Piaget, Vygotsky and Bruner. The term constructivism is defined as constructing new knowledge
from prior experience [Newby et al 1996].

There are eight principles in which knowledge construction can be facilitated [Jonassen 1994]:

1. Provide multiple representations of reality;
2. Represent the natural complexity of the real world;
3. Focus on knowledge construction, not reproduction;
4. Present authentic tasks - contextualizing rather than abstracting instruction;
5. Provide real-world, case-based learning environments, rather than predetermined instructional sequences;
6. Foster reflective practice;
7. Enable context-and content dependent knowledge construction;
8. Support collaborative construction of knowledge through social negotiation.

Constructivists believe that humans are active learners. They construct new knowledge based on their prior experiences. In a constructivism environment, learning becomes an active process of constructing knowledge in such a way that the learner builds on prior knowledge and experience to draw meaning and construct new knowledge. The instructor is a facilitator that encourages interaction and helps creates social disclosure.

Honebein [1996] put forward seven goals in designing constructivist learning environments:

1. Provide experience with the knowledge construction process;
2. Provide experience in and appreciation for multiple perspectives;
3. Embed learning in realistic and relevant contexts;
4. Encourage ownership and voice in the learning process;
5. Embed learning in social experience;
6. Encourage the use of multiple modes of representation; and
7. Encourage self-awareness in the knowledge construction process.

In a constructivism environment, knowledge construction takes place in individual contexts and through social disclosure, collaboration, and experience. Learning situations represent the normal complexities of the real world. Multiple perspectives and multiple representations that encourage cooperative and collaborative learning are encouraged.
Important sub-streams of constructivism are:

- Cognitive apprenticeship;
- Situated learning (in an actual, real learning environment);
- Goal based learning (the use of the learners individual interests);
- Anchored instruction (with an anchor stimulus at the beginning of a learning process designed to attract attention and create interest), Anchored instruction [Bransford 1990] is the basis for case based learning (CBL) and problem based learning (PBL).

In brief, the main goal of constructivism is competence, not knowledge as in cognitivism or achievement as in behaviorism. The constructivism learning theory has been praised by researchers as a compatible and appropriate design for e-Learning instruction [Bannan-Ritland et al 2000. Hung 2001. Hung&Nichani 2001. Oliver 1999].

### 2.2.4 Student-Centered Teaching

In arguing on a learning style that has significance for the individual, Carl Rogers describes whole-person learning, being the goal of Student-Centered Teaching, as follows: "Significant learning combines the logical and the intuitive, the intellect and the feelings, the concept and the experience, the idea and the meaning. When we learn in that way, we are wholly utilizing all our masculine and feminine capacities." [Rogers 1983]. In this spirit, Student-Centered Teaching can be characterized by the following goals. It aims toward [Rogers 1983]:

- A climate of trust in which curiosity and the natural desire to learn can be nourished and enhanced;
- A participatory mode of decision-making in all aspects of learning in which students, teachers, and administrators have their part;
- Helping students to achieve results they appreciate and consider worthwhile, to build their self-esteem and confidence;
- Uncovering the excitement in intellectual and emotional discovery, which leads students to become life-long learners;
- Developing in teachers the attitudes that research has shown to be most effective in
facilitating learning;

- Helping teachers to grow as persons finding rich satisfaction in their interactions with learners.

The Student-Centered approach is based on the empirically proved hypothesis [Aspy 1972] that students achieve superior academic results and even personal growth in terms of higher self-confidence, openness to experience, etc., if they learn in an atmosphere or climate that can be characterized by three basic attitudinal conditions: realness, acceptance, and empathic understanding. These necessary and sufficient conditions must be held or lived by the instructor, better facilitator, and reciprocally be perceived by the students (see Figure 4).

- **Realness**, genuineness, or transparency in the facilitator means that he or she must be real in the relationship with his/her student, be the person he/she is and not use any masks of facades in communicating with the students.

- **Acceptance**, prizing, or respect towards student implies that the facilitator accepts and respects the whole personality of the student and feels basic trust in his or her constructive tendency, his/her striving for solutions in his/her own way.

- **Deep understanding**, often called empathic understanding, means that the facilitator actively listens to the students with the ultimate goal to profoundly understand their questions, motivations, intentions, and the meanings of their communication as well as solutions.

Besides the above attitudinal conditions that contribute to establishing a facilitating, fruitful atmosphere for learning, Carl Rogers proposes three more conditions for essential, whole-person learning [Rogers 1961]:

```
Significant learning occurs more readily in relation to situations perceived and recognized as problems by those who wish to learn. Students in required courses are apt to view the course as an experience in which he/she expects to remain passive. The essential implication of this observation is that we need to permit students, at any level, to be in real contact with problems they consider relevant, so that they perceive problems and issues they really care about and wish to resolve.

There exist many resources of knowledge, techniques, of theory, which constitute raw material for use. It seems that these resources be made available to students, not forced upon them. Aside of the usual resources, such as books, maps, tools, materials --- both in electronic form or in as hardcopies ---, the instructor can be considered as a human resource, who would want to make himself or herself available to his/her class in numerous ways. Yet, lecturing should be perceived as an offer rather than a must. In general, whatever resource the teacher supplies – he/she would feel and hope to be perceived as offerings to be used rather than guides or requirements.

The basic humanistic hypothesis upon which the teacher builds is that students who are in contact with real problems wish to learn, want to grow, seek to find out or desire to create. He/she sees his/her function as that of developing a climate in the class that these tendencies can evolve.

Briefly, Student-Centered Teaching requires particular personal attitudes from the facilitator as well as at least a certain degree of openness from the side of the curriculum as
well as the students. From personal experience we'd like to add the requirement on, or at least the benefit of social skills and techniques such as moderation [Freimuth 2000]. These help to make group processes more transparent, to converge faster and hence to improve student satisfaction [Bruffee 1999].

2.3 e-Learning platforms and comparison

This comparison covers the non-subjective and comparable features of the main web-based Course Management Systems (CMSs): Angel, BlackBoard, Desire2Learn, Moodle, Sakai and WebCT. For the most part, features are identified as present or missing but are not evaluated. Features that are common to all are mostly ignored.

(Data source: Http://ctlet.brocku.ca/webct/LMS_Options_and_Comparisons) accessed at 2006-01-19

2.3.1 Angel

ANGEL provides a complete suite of simple, yet powerful online teaching and learning tools for universities, colleges and other higher education programs. Flexible, scalable and open, ANGEL LMS 7 offers institutions the powerful features and extensible capabilities they need with a simple interface that requires less training and supports both new and power users’ requirements.

The features of Angel include (http://angellearning.com/):

**Automated Agent Console:** Magnify your ability to monitor and react to student activity with enhanced agent technology. Located in one central location, ANGEL’s agents offer powerful pattern recognition with many automated activity options.

**Central Report Console:** Access your favorite ANGEL reports in one central location. Advanced reporting capabilities combine ANGEL’s unique ability to simplify tasks with potent data mining technology. It’s easy to save reports for future use, or export them to PDF. An added bonus is the resulting time-savings and increased workflow efficiencies for the instructor.

**Course Home Page Assembles Perspective:** This single location presents a “digital dashboard” of visual summaries and navigation options instantly at login. Visual graphics
immediately communicate pertinent course information (as shown in figure 5).

Figure 5 Course Home Page Assembles Perspective of Angel

In the clients list, over 70 universities and colleges selected Angel as CMS for their courses, and the voice comes from users like:

“The University of Kansas Medical Center selected ANGEL for the diversity of solutions it provides for course delivery support and support, collaboration, and curriculum sharing. We have found the company to be learner-centered and willing to listen to customer suggestions to improve the product.” -Darrin Cheney, Director of Teaching and Learning Technologies, University of Kansas Medical Center

“Faculty reception of ANGEL has been outstanding. Within two weeks of the initial ANGEL rollout, the university had to nearly double its ANGEL license.” -Dr. Mike Clay, Directory of Learning Technology, Seattle University

Table 1 Primary data of Angel

<table>
<thead>
<tr>
<th>Publisher</th>
<th>Angel Learning</th>
</tr>
</thead>
<tbody>
<tr>
<td>License</td>
<td>Commercial</td>
</tr>
</tbody>
</table>

**TEACHING TOOLS:**

- **Distribute External Content**: YES - External content HTML sites to web pages, PowerPoint, PDF
- **Distribute Internal Content**: Create internal HTML files and textboxes
- **Discussions (asynchronous)**: Yes - Modify messages after posting, Threaded
- **Chat (synchronous)**: Yes
- **E-Mail/Internal Messaging**: Both
<table>
<thead>
<tr>
<th>Feature</th>
<th>Availability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Calendar/Schedule</td>
<td>yes</td>
</tr>
<tr>
<td>Testing/Surveys</td>
<td>yes - Equation Editor, no Likert, No calculate Numeric, No MC w/ Partial credit,</td>
</tr>
<tr>
<td>Announcements</td>
<td>Yes</td>
</tr>
<tr>
<td>URL Management</td>
<td>Yes</td>
</tr>
<tr>
<td>Grade Book</td>
<td>Yes</td>
</tr>
<tr>
<td>File Management</td>
<td>WebDAV support, Instructor/Student file storage, Quotas</td>
</tr>
<tr>
<td>WYSIWYG/HTML Input</td>
<td>Yes (strange full-screen pop-up)</td>
</tr>
<tr>
<td>Assignment Drop box</td>
<td>Yes</td>
</tr>
<tr>
<td>Group Work &amp; Selective Release</td>
<td>Yes - Teams can be assigned or randomly created</td>
</tr>
</tbody>
</table>

**TECHNICAL:**

<table>
<thead>
<tr>
<th>Feature</th>
<th>Availability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Server Architecture</td>
<td>MS Windows</td>
</tr>
<tr>
<td>Database Driven</td>
<td>Yes - MSSQL</td>
</tr>
<tr>
<td>SCORM or IMS Compliant</td>
<td>Both</td>
</tr>
<tr>
<td>Authentication</td>
<td>LMS based accounts</td>
</tr>
<tr>
<td>Tracking &amp; Reporting</td>
<td>Limited - Course stats, report by user &amp; date, not by content piece</td>
</tr>
<tr>
<td>API/RSS/XML/Portal Support</td>
<td>Has portal API</td>
</tr>
</tbody>
</table>

**OTHER:**

<table>
<thead>
<tr>
<th>Feature</th>
<th>Availability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Turnitin Support</td>
<td>Yes</td>
</tr>
<tr>
<td>Textbook Publisher Support</td>
<td>McGraw Hill, Pearson, Thomson, Mosby, Elsevier and Bedford, Freeman &amp; Worth Publishing Group (only!)</td>
</tr>
<tr>
<td>Notable</td>
<td>Used by University of Waterloo for some aspects of online instruction</td>
</tr>
</tbody>
</table>

### 2.3.2 Blackboard

Blackboard Thinks their "role is to improve the educational experience with Internet-enabled technology that connects students, faculty, researchers and the community in a growing network of education environments dedicated to better communication, commerce, collaboration and content." ([http://www.blackboard.com](http://www.blackboard.com))

It is recognized that:

- Networked Learning Environment: teaching and learning should occur beyond the classroom and built products in support of anytime, anywhere learning
- Networked Transaction Environment: any member of the University community can use just one card to enable on and off-campus commerce transactions, activities, facilities access, and web services.
After the merge of WebCT (it is completed at 02/28/2006), Blackboard have 3700 customers, becomes the biggest commercial CMS suppler.

<table>
<thead>
<tr>
<th>Table 2 Primary data of Blackboard</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Publisher</strong></td>
</tr>
<tr>
<td><strong>License</strong></td>
</tr>
</tbody>
</table>

**TEACHING TOOLS:**

<table>
<thead>
<tr>
<th><strong>Distribute External Content</strong></th>
<th>YES - External content HTML sites to web pages, PowerPoint, PDF, publishable from Desktop</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Distribute Internal Content</strong></td>
<td>Yes/No - Create internal HTML files via WYSIWIG, Spell Check</td>
</tr>
<tr>
<td><strong>Discussions (asynchronous)</strong></td>
<td>Yes - Modify messages after posting, Threaded, Appoint moderator, Allows users to remove message,</td>
</tr>
<tr>
<td><strong>Chat (synchronous)</strong></td>
<td>Yes</td>
</tr>
<tr>
<td><strong>E-Mail/Internal Messaging</strong></td>
<td>Both</td>
</tr>
<tr>
<td><strong>Calendar/Schedule</strong></td>
<td>Yes</td>
</tr>
<tr>
<td><strong>Testing/Surveys</strong></td>
<td>Yes - Equation Editor, Has Likert and many other types</td>
</tr>
<tr>
<td><strong>Announcements</strong></td>
<td>Yes</td>
</tr>
<tr>
<td><strong>URL Management</strong></td>
<td>Yes</td>
</tr>
<tr>
<td><strong>Grade Book</strong></td>
<td>Yes - Extensive</td>
</tr>
<tr>
<td><strong>File Management</strong></td>
<td>WebDAV support, Instructor/Student file storage, Quotas</td>
</tr>
<tr>
<td><strong>WYSIWYG/HTML Input</strong></td>
<td>Yes</td>
</tr>
<tr>
<td><strong>Assignment Drop box</strong></td>
<td>Yes</td>
</tr>
<tr>
<td><strong>Group Work &amp; Selective Release</strong></td>
<td>Yes - Groups can be managed, joined and auto-created</td>
</tr>
</tbody>
</table>

**TECHNICAL:**

<table>
<thead>
<tr>
<th><strong>Server Architecture</strong></th>
<th>Linux/MS Windows</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Database Driven</strong></td>
<td>Yes - Oracle</td>
</tr>
<tr>
<td><strong>SCORM or IMS Compliant</strong></td>
<td>Both + NLN</td>
</tr>
<tr>
<td><strong>Authentication</strong></td>
<td>LMS based accounts, LDAP</td>
</tr>
<tr>
<td><strong>Tracking &amp; Reporting</strong></td>
<td>Extensive</td>
</tr>
<tr>
<td><strong>API/RSS/XML/Portal Support</strong></td>
<td>Has portal API</td>
</tr>
</tbody>
</table>

**OTHER:**

<table>
<thead>
<tr>
<th><strong>Turnitin Support</strong></th>
<th>Yes</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Textbook Publisher Support</strong></td>
<td>Everyone who is creating electronic content</td>
</tr>
<tr>
<td><strong>Notable</strong></td>
<td>Was beating WebCT in features until summer of 2005…. Then they bought WebCT.</td>
</tr>
</tbody>
</table>
2.3.3 Desire2Learn

Founded in 1999, Desire2Learn Inc. is a leader in providing innovative e-Learning solutions to academic and other leading organizations around the world. The products include web-based Learning Platform (LMS/CMS), Learning Object Repository, and other innovative technology (http://www.desire2learn.com/).

D2L Standards and Specifications Leadership

D2L was the first and only academic LMS to achieve full certification for both SCORM 1.2 RTE 3 and SCORM 2004 from Advanced Distributed Learning (ADL). This certification provides assurance of interoperability of content and content interaction within the LMS between different systems supporting SCORM.

D2L student information system (SIS) integration is based on IMS-Enterprise; thus, your content can be imported in to, and exported from, the D2L Learning Platform using IMS-CP and IMS-QTI.

D2L Learning Object Repository (LOR) is based on IEEE LOM and supports many additional Metadata Application Profiles such as CanCore, GEM, Dublin Core and custom profiles.

The notable users in the customer list include the University of Arizona, Fanshawe College, the University of Guelph, etc.

<table>
<thead>
<tr>
<th>Publisher</th>
<th>Desire2Learn</th>
</tr>
</thead>
<tbody>
<tr>
<td>License</td>
<td>Commercial</td>
</tr>
</tbody>
</table>

**TEACHING TOOLS:**

<table>
<thead>
<tr>
<th>Feature</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Distribute External Content</td>
<td>YES - External content HTML sites to web pages, PowerPoint, PDF</td>
</tr>
<tr>
<td>Distribute Internal Content</td>
<td>Create internal HTML files via WYSIWIG, Spell Check</td>
</tr>
<tr>
<td>Discussions (asynchronous)</td>
<td>Yes - Modify messages after posting, Threaded, Appoint moderator, Allows users to remove messages</td>
</tr>
<tr>
<td>Chat (synchronous)</td>
<td>Yes and whiteboard capabilities</td>
</tr>
<tr>
<td>E-Mail/Internal Messaging</td>
<td>Both</td>
</tr>
<tr>
<td>Calendar/Schedule</td>
<td>Yes</td>
</tr>
<tr>
<td>Testing/Surveys</td>
<td>Yes - Equation Editor, and other types</td>
</tr>
<tr>
<td>Announcements</td>
<td>Yes</td>
</tr>
<tr>
<td>URL Management</td>
<td>Yes - monitors broken links</td>
</tr>
<tr>
<td>Grade Book</td>
<td>Yes - Extensive</td>
</tr>
</tbody>
</table>

Table 3 Primary data of Desire2Learn
### File Management
- WebDAV support, Instructor/Student file storage, Quotas

### WYSIWYG/HTML Input
- Yes - Plus spell check

### Assignment Drop box
- Yes

### Group Work & Selective Release
- Yes

### Technical:
- **Server Architecture**: MS Windows
- **Database Driven**: unknown
- **SCORM or IMS Compliant**: Both (IMS: Course Packaging, Enterprise QTI)
- **Authentication**: LMS based accounts, LDAP, Active Directory
- **Tracking & Reporting**: Extensive
- **API/RSS/XML/Portal Support**: Has portal API

### Other:
- **Turnitin Support**: No
- **Textbook Publisher Support**: None (Officially)
- **Notable**: Can import WebCT courses

## 2.3.4 Moodle

Moodle is a course management system (CMS) - a free, Open Source software package designed using sound pedagogical principles, to help educators create effective online learning communities. It can scale from a single-teacher site to a 50,000-student University (http://moodle.org). It's an ongoing development project designed to support a social constructionist framework of education. The word Moodle was originally an acronym for Modular Object-Oriented Dynamic Learning Environment, which is mostly useful to programmers and education theorists. It's also a verb that describes the process of lazily meandering through something, doing things as it occurs to you to do them, an enjoyable tinkering that often leads to insight and creativity. As such it applies both to the way Moodle was developed, and to the way a student or teacher might approach studying or teaching an online course. Anyone who uses Moodle is a Moodler.

Moodle has a large and diverse user community with over 100,000 registered users on this site alone, speaking over 70 languages in over 150 countries.

### The Open University builds student online environment with Moodle

(http://moodle.org/mod/forum/discuss.php?d=34002)

Currently Open University students use a variety of software in a network to access their course work, interact with tutors and other students, use the library, submit assignments and
handle administrative paperwork. The new development incorporating Moodle will ensure the network is much more user-friendly and uniform.

Dean Taylor, the program manager of the OU’s Virtual Learning Environment (VLE), says, “We see the development of Moodle applications, along with involvement of the Moodle Open Source community giving our students a great advantage in e-learning. Plus, the innovations added by the OU will be available to the entire Moodle community. It’s a two-way creative street.”

Martin Dougiamas, Moodle community leader and lead developer, says he is very proud that the OU has chosen Moodle as the platform for its next generation of internet-based courses. “By joining our community they are recognizing the great value of the open source paradigm and the power of a social constructionist approach to both learning and development. At the same time, as one of the largest, oldest and most respected practitioners of distance education in the world they bring resources and experience that will give Moodle development a tremendous boost in the coming years.”

Table 4 Primary data of Moodle

<table>
<thead>
<tr>
<th>Publisher</th>
<th>Moodle Community, Martin Dougiamas, GNU</th>
</tr>
</thead>
<tbody>
<tr>
<td>License</td>
<td>Open Source: GPL</td>
</tr>
<tr>
<td><strong>TEACHING TOOLS</strong></td>
<td></td>
</tr>
<tr>
<td>Distribute External Content</td>
<td>YES - External content HTML sites to web pages, PowerPoint, PDF</td>
</tr>
<tr>
<td>Distribute Internal Content</td>
<td>YES - Create internal HTML files via WYSIWIG, Spell Check</td>
</tr>
<tr>
<td>Discussions (asynchronous)</td>
<td>YES - Modify messages after posting (within time set by Administrator, 30 min. is the default), Threaded, Appoint moderator, Allows users to remove message</td>
</tr>
<tr>
<td>Chat (synchronous)</td>
<td>YES</td>
</tr>
<tr>
<td>E-Mail/Internal Messaging</td>
<td>Both</td>
</tr>
<tr>
<td>Calendar/Schedule</td>
<td>YES, Activities (quiz, assignment, etc.) due dates are posted to the calendar automatically, teachers can create course events and personal events, students can create personal events.</td>
</tr>
<tr>
<td>Testing/Surveys</td>
<td>YES - No Equation Editor, has TeX support.</td>
</tr>
<tr>
<td>Announcements</td>
<td>YES</td>
</tr>
<tr>
<td>URL Management</td>
<td>YES</td>
</tr>
<tr>
<td>Grade Book</td>
<td>YES, with category weighting, extra credit, and user exclusions.</td>
</tr>
<tr>
<td>File Management</td>
<td>WebDAV support, courses own files, not instructors or students</td>
</tr>
<tr>
<td>WYSIWYG/HTML Input</td>
<td>YES - Plus spell check</td>
</tr>
<tr>
<td>Assignment Drop box</td>
<td>YES</td>
</tr>
<tr>
<td>Group Work &amp; Selective Release</td>
<td>YES</td>
</tr>
<tr>
<td><strong>TECHNICAL</strong></td>
<td></td>
</tr>
<tr>
<td>Server Architecture</td>
<td>UNIX/Linux/bsd/OSX... and MS Windows</td>
</tr>
<tr>
<td>Database Driven</td>
<td>YES, MySQL or PostgreSQL</td>
</tr>
<tr>
<td>SCORM or IMS Compliant</td>
<td>Both</td>
</tr>
<tr>
<td>Authentication</td>
<td>LMS based accounts, LDAP, IMAP, POP3, NNTP (and “any external database containing at least two fields”)</td>
</tr>
<tr>
<td>----------------</td>
<td>-----------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Tracking &amp; Reporting</td>
<td>Yes</td>
</tr>
<tr>
<td>API/RSS/XML/Portal Support</td>
<td>RSS, open and documented database structure and code that can be modified.</td>
</tr>
<tr>
<td><strong>OTHER:</strong></td>
<td></td>
</tr>
<tr>
<td>Turnitin Support</td>
<td>No.</td>
</tr>
<tr>
<td>Textbook Publisher Support</td>
<td>No course cartridge, imports test questions from many formats.</td>
</tr>
<tr>
<td>Notable</td>
<td>Dashboard Widget for Mac OS 10.4. Different in appearance than WebCT 4.1, but feature for feature similar. Built in support for SCORM, HotPotatoes, &amp; Flash based activities. Imports Blackboard 5.5 and WebCT 4.1 courses.</td>
</tr>
</tbody>
</table>

### 2.3.5 Sakai

The Sakai Project, announced in January 2004, promised to develop an open source Collaboration and Learning Environment for the needs of higher education. The Sakai Software is already deployed as the primary teaching and learning system at the University of Michigan with over 35,000 users. It is in a full parallel year at Indiana with deployment to 90,000. Major pilot projects and rollouts are underway at Stanford, UC-Berkeley, MIT, Rutgers, Yale, UC-Merced, UNISA (University of South Africa), Universitat de Lleida (Spain), Roskilde Universitetscenter (Denmark), Universidade Fernando Pessoa (Portugal), and others (see Sakai Pilot Projects at SakaiProject.org) (http://sakaiproject.org/).

Sakai Foundation to provide a permanent home for the growing Sakai Community. As a non-profit, membership corporation the Sakai Foundation will provide Sakai developers, adopters, and users a place to coordinate their efforts. The Foundation will manage a small staff to coordinate evolution of the Sakai software, provide advanced developer support for members, conduct quality assurance work on Sakai releases, track contributor agreements and manage the Sakai IP, and manage conferences and meetings for the Sakai Community. Much of the innovation and tool development will continue to be done where it is best understood -- among the distributed community of Sakai users and developers.

The Sakai Project is an actively evolving ecosystem that currently consists of a community of core schools, which are developing the framework and basic set of collaboration and learning tools (and have released 2 major release to date), the Sakai Educational Partners Program with a membership of over 65 actively engaged institutions, the Sakai Commercial Affiliates vendors who offer support and hosting for the Sakai CLE, and the public contributors to the open source project. All of these participants contribute to the project in a variety of ways and, ultimately, to the development and support of the open source collaboration and learning environment and its tools.

The tools and features of Sakai is show as following:
### Brief descriptions of the tools and features that make up Sakai:

<table>
<thead>
<tr>
<th>Announcements Tool</th>
<th>Membership Tool</th>
<th>Site Info Tool</th>
</tr>
</thead>
<tbody>
<tr>
<td>Assignments Tool</td>
<td>My Workspace</td>
<td>Syllabus Tool</td>
</tr>
<tr>
<td>Chat Room Tool</td>
<td>News Tool</td>
<td>Synoptic Tool</td>
</tr>
<tr>
<td>Discussion Tool</td>
<td>Permissions and Roles</td>
<td>WebDAV</td>
</tr>
<tr>
<td>Drop Box Tool</td>
<td>Preferences</td>
<td>Website Information Tool</td>
</tr>
<tr>
<td>Email Archive Tool</td>
<td>Quiz and Test Tool</td>
<td>Website Setup Tool</td>
</tr>
<tr>
<td>Help Tool</td>
<td>Resources Tool</td>
<td></td>
</tr>
<tr>
<td>Home</td>
<td>Schedule Tool</td>
<td></td>
</tr>
</tbody>
</table>

### Table 5 Primary data of Sakai

<table>
<thead>
<tr>
<th>Publisher</th>
<th>Sakai Project</th>
</tr>
</thead>
<tbody>
<tr>
<td>License</td>
<td>Open Source: Sakai Software License: part of GNU Educational Community License, similar to GPL</td>
</tr>
</tbody>
</table>

**TEACHING TOOLS:**

<table>
<thead>
<tr>
<th>Distribute External Content</th>
<th>Yes - External content HTML sites to web pages, PowerPoint, PDF</th>
</tr>
</thead>
<tbody>
<tr>
<td>Distribute Internal Content</td>
<td>Yes</td>
</tr>
<tr>
<td>Discussions (asynchronous)</td>
<td>Yes - one default category, chose others from drop-box</td>
</tr>
<tr>
<td>Chat (synchronous)</td>
<td>Yes</td>
</tr>
<tr>
<td>E-Mail/Internal Messaging</td>
<td>Internet E-Mail only</td>
</tr>
<tr>
<td>Calendar/Schedule</td>
<td>Yes</td>
</tr>
<tr>
<td>Testing/Surveys</td>
<td>Yes - basic question types</td>
</tr>
<tr>
<td>Announcements</td>
<td>Yes</td>
</tr>
<tr>
<td>URL Management</td>
<td>Yes</td>
</tr>
<tr>
<td>Grade Book</td>
<td>Yes</td>
</tr>
<tr>
<td>File Management</td>
<td>Web based and WebDAV</td>
</tr>
<tr>
<td>WYSIWYG/HTML Input</td>
<td>Yes</td>
</tr>
<tr>
<td>Assignment Drop box</td>
<td>Yes</td>
</tr>
<tr>
<td>Group Work &amp; Selective Release</td>
<td>Yes - Groups can be managed, joined and auto-created</td>
</tr>
</tbody>
</table>

**TECHNICAL:**

<table>
<thead>
<tr>
<th>Server Architecture</th>
<th>UNIX/Linux/BSD/OSX... and MS Windows NT and later - needs Tomcat</th>
</tr>
</thead>
<tbody>
<tr>
<td>Database Driven</td>
<td>HSQLDB or MySQL</td>
</tr>
<tr>
<td>SCORM or IMS Compliant</td>
<td>Both</td>
</tr>
<tr>
<td>Authentication</td>
<td>LMS based accounts, LDAP</td>
</tr>
<tr>
<td>Tracking &amp; Reporting</td>
<td>Yes</td>
</tr>
<tr>
<td>API/RSS/XML/Portal Support</td>
<td>Import (only?)</td>
</tr>
<tr>
<td>---------------------------</td>
<td>---------------</td>
</tr>
</tbody>
</table>

**OTHER:**

<table>
<thead>
<tr>
<th>Turnitin Support</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>Textbook Publisher Support</td>
<td>A lot of intent, developing an open standard</td>
</tr>
<tr>
<td>Notable</td>
<td>Being piloted by a number of US institutions. Rumors of IBM, Red Hat, etc. selling Sakai packages in the future.</td>
</tr>
</tbody>
</table>

### 2.3.6 WebCT Campus Edition

WebCT is a trusted industry leader in providing e-learning systems for educational institutions. Thousands of institutions in more than 70 countries worldwide are expanding the boundaries of teaching and learning with WebCT (http://www.webct.com/).

<table>
<thead>
<tr>
<th>Publisher</th>
<th>WebCT, Inc (merger with Blackboard pending approval by government regulatory agencies)</th>
</tr>
</thead>
<tbody>
<tr>
<td>License</td>
<td>Commercial</td>
</tr>
<tr>
<td><strong>TEACHING TOOLS:</strong></td>
<td></td>
</tr>
<tr>
<td>Distribute External Content</td>
<td>Yes - External content HTML sites to web pages, PowerPoint, PDF, publishable from Desktop</td>
</tr>
<tr>
<td>Distribute Internal Content</td>
<td>Yes/No - why?</td>
</tr>
<tr>
<td>Discussions (asynchronous)</td>
<td>Yes - Threaded, can add moderators and edit postings</td>
</tr>
<tr>
<td>Chat (synchronous)</td>
<td>Yes - whiteboard added/amalgamated</td>
</tr>
<tr>
<td>E-Mail/Internal Messaging</td>
<td>Internal</td>
</tr>
<tr>
<td>Calendar/Schedule</td>
<td>Yes</td>
</tr>
<tr>
<td>Testing/Surveys</td>
<td>Yes - Equation Editor, Has other types</td>
</tr>
<tr>
<td>Announcements</td>
<td>Yes</td>
</tr>
<tr>
<td>URL Management</td>
<td>Yes</td>
</tr>
<tr>
<td>Grade Book</td>
<td>Yes - Extensive</td>
</tr>
<tr>
<td>File Management</td>
<td>WebDAV support, Instructor/Student file storage, Quotas</td>
</tr>
<tr>
<td>WYSIWYG/HTML Input</td>
<td>Yes</td>
</tr>
<tr>
<td>Assignment Drop box</td>
<td>Yes</td>
</tr>
<tr>
<td>Group Work &amp; Selective Release</td>
<td>Yes - Groups can be managed, joined and auto-created</td>
</tr>
</tbody>
</table>

**TECHNICAL:**

<table>
<thead>
<tr>
<th>Server Architecture</th>
<th>UNIX/Linux/BSO/OSX... and MS Windows</th>
</tr>
</thead>
<tbody>
<tr>
<td>Database Driven</td>
<td>Yes - MSSQL or Oracle</td>
</tr>
<tr>
<td>SCORM or IMS Compliant</td>
<td>Both</td>
</tr>
<tr>
<td>Authentication</td>
<td>LMS based accounts, LDAP</td>
</tr>
<tr>
<td>Tracking &amp; Reporting</td>
<td>Extensive</td>
</tr>
</tbody>
</table>
WebCT Campus Edition is a market-leading course management system used by institutions around the world, in all stages of e-learning deployment. Built on a strong technical foundation, WebCT Campus Edition includes a Virtual Course Environment with a complete set of tools for course preparation, delivery, and management, resulting in an e-learning system that is easy to use, innovative, and reliable.

Although Blackboard’s pledge to continue to offer and support WebCT products (http://www.blackboard.com/webct/faqs.htm), but many distrust and confuse has rising form all the higher education sector, all the reaction and comment about the “Blackboard Acquisition of WebCT” can be found by access http://www.downes.ca/cgi-bin/page.cgi?post=31687.

### 2.4 e-Learning industrial technology and standards

The industrial and information ages run on standards: standards that allow screws to fit bolts and data to be transmitted and received. But standards look a lot different after they have been created, accepted, and adopted than when vendors are still negotiating over which standard is best and a long list of proposals are competing for consideration. E-Learning is in transition from the lawless “before standards” state to a more stable “with standards” state where the content and capabilities of product vendors can compete on a more stable basis.

Until very recently, the creation and implementation of learning technology has been left up to small communities of practice, rarely larger than a school district, university, or company training department and sometimes much smaller. Now, however, economies of scale and the existence of worldwide communication networks are driving learning technology toward globally scalable solutions. Such solutions cannot exist without standards anymore than the Internet can exist without standards such as TCP, IP, HTTP, and HTML.

Interoperability among e-learning content and system components is a key to the successful implementation of an e-learning environment. There are several e-learning
interoperability specifications and standards at various stages of development and adoption that are being promoted by various organizations and consortiums [Sun 2002].

2.4.1 e-Learning Systems

e-Learning system is a solution involving the use of all or part of followings:

- hardware (e.g. computer, network)
- software (e.g. system software and LMS or CMS, content produce tools)
- pedagogy or Philosophy of education
- education or training content components that adhere certain standard
- Faculty, learners, administrator and support staff

All of the above integrated together to provide teaching and learning facilities for the stakeholders of the education institutes.

2.4.2 Learning Objects

From an operational perspective, learning objects are chunks of data that are used by e-Learning system—they are authored, stored, cataloged, assembled, delivered, and reported on. A more down-to-earth approach is to think of a learning object as a digital part of a course ranging in size and complexity from a single graphic to an entire course itself.

Learning Objects have many benefits. These benefits are reduced costs, personalized learning, interoperability, standardization, and customization [Elearnspace 2004].

2.4.3 Technology Infrastructure

The technology infrastructure must have the capacity to support the users and network load, it must be scalable to support growth, it must be stable to ensure a high level of availability for learners, it must provide an open environment to support interoperability between components, and it must provide security to protect distributed users and content.

To effectively implement e-Learning it is essential to have: a clear understanding of how e-Learning will support overall learning objectives; e-Learning content that addresses those objectives; tools to develop, manage and deliver the learning; and a technology infrastructure that will support the tools and the delivery of content.

The technology infrastructure must have the necessary capacity to support the demands
that e-Learning will generate in terms of network load, it must be scalable to support growth, it must be stable to ensure a high level of availability for learners, it must provide an open environment and tools that support interoperability of the various components of the e-Learning solution, and it must provide security to protect distributed users and content.

2.4.4 e-Learning functional model

To understand how different systems might work together, it is useful to have a simple functional model of an e-Learning application environment. Figure 6 below provides a visual representation of the components that make up an e-Learning environment and the objects that must be moved among these components. This is not an architecture reference model for use by engineers but rather a conceptual model that can be used to position e-Learning products and their functionality in an e-Learning environment.

Source: Eduworks Corporation, 2002 – www.eduworks.com

Figure 6 e-Learning functional model

Content Repositories and Offering Catalogs

Content Repositories are learning object storehouses that can be accessed on one hand by people and systems creating content and on the other hand by people and systems using the content. Repositories must be able to handle commercially available “off the shelf” content as well as more specialized content created in-house or on the spot.

Metadata

To interface effectively with other components, content repositories must maintain a
searchable index of learning objects and, ideally, descriptive information about the structure and properties of the objects. This descriptive information is called metadata, or more precisely, learning object metadata. Metadata is used to support search, discovery, and retrieval of learning objects.

**Metadata and Content Storage**

If one thinks of a traditional library, the metadata is analogous to a card catalog and the content is analogous to the books. Even in a library the cards are kept separate from the books, and in the digital age content repositories often only contain metadata. The content in repositories takes many forms including text, graphics, assessment questions, photos, animation, simulation, audio, and video. The physical storage and retrieval of content objects may be completely separate from the storage and retrieval of the metadata about those learning objects. In fact, the learning objects may be stored on multiple servers with different characteristics. This is a technologically sound approach both to gain efficiency in delivering the actual content to learners and because different media demand different types of servers.

**Reusable Learning Objects**

Learning object repositories allow users to develop, index, find, and reuse learning objects. This requires the objects to be indexed with learning metadata, and often requires the ability to mix and match learning objects from different sources and delivers them in different systems. The big picture of reusable learning objects requires many components to cooperate.

**Offering Catalog**

A learning offering is defined as content that is assembled into a package of learning (ideally including assessment components) that is then offered to learners as a unit. An offering catalog is a special kind of repository that contains offerings. An offering catalog may associate offerings with learning paths that lead to degrees, certifications and/or skills. Depending on the physical architecture of the learning environment, this catalog may be integrated with a more general content repository or may be a separate component.
**Content Authoring Tools**

Content authoring tools and services allow subject matter experts and instructional developers to create and modify learning content objects.

Professional instructional developers typically require their tools to provide a rich set of functions, whereas ordinary instructors are better served by tools that are easy to use and learn, and provide standard templates for the content being developed.

It is important for authoring tools to allow content authors to locate existing content to reuse or repurpose it rather than completely recreate it. This requires instructional designers, content providers, or course developers to accurately provide metadata descriptions of their content.

**Content Assembly Tools**

Content assembly refers to the linking of content objects together into cohesive learning modules, with navigation between objects clearly defined and with assessments associated to appropriate content. Content assembly is frequently performed using a different tool than the authoring tool used to create the learning objects, although many authoring tools include assembly capabilities.

A content template is an efficient way that acts as the basis for packaging content consistently into learning modules. Templates may be based on the structure, on presentation, on instructional design methods, or on all three. Thus a template might divide a lesson into an introduction, explanation, example, and assessment; have a background that can be branded with a school or company logo; and include slots for text, graphics, animations, and quizzes.

**Catalog Manager**

Catalog management is the process of defining the learning that will be offered to different audiences, establishing learning plans (degree paths, certification paths, and skill development curricula), scheduling the resources needed to support learning delivery, establishing the business processes for registering learners in offerings, and making the offering catalog accessible to the target audiences.

This process can be very simple in an organization that is releasing a small number of
self-paced learning products to its internal employees, or extremely complex, as in the case of a large educational organization that delivers thousands of instructor-led courses to a large and varied learner audience.

Catalog manager components are typically interfaces that allow authorized individuals to make learning available and to set access rules, restrictions, prices, and so on.

**Learner Profile Manager**

Learning is ultimately about learners and therefore e-Learning systems typically keep information about the learners that use them. This information includes: personal data, learning plans (degree plan, for example), learning history, certifications and degrees, assessments of knowledge (skills and competencies), and the status of participation in active learning (registration, progress). The sum total of this information is called a learner profile, and e-Learning systems require a component that manages this profile. The learner profile manager makes learner information available to other components and retrieves and updates learner information on the basis of data reported by other components.

**Learning Planner**

Depending on the organizational context, learning can be planned by learners themselves, by teachers, by advisors, by curriculum administrators, by HR (Human Resource) managers, and by line managers.

Learning planning requires access to the offerings and learning paths in the offering catalog, and to information about the learner from the learner profile repository. Learning plans should be viewed as a core part of a learner profile and stored as such for ongoing progress tracking.

**Learner Registrar**

The learner registrar component provides learners with access to learning offerings and administers the business processes related to that access. The complexity of the process can vary immensely, from a simple click on a catalog item by a learner that provides immediate access, to complex processes that include instructor approval, checking seat availability, prerequisite checking, payment calculation, payment processing, cancellation and refund policies, etc.
**Delivery Environment**

The delivery environment provides the learner with access to learning content and other components of a learning environment such as chat, email, quizzes, multimedia players, collaboration tools, application sharing, shared whiteboards, equation editors, etc. The environment also provides tools for instructors, if there is an instructor-led component of the learning.

The delivery environment also provides navigation through the content, sometimes under learner control, sometimes under instructor control, and sometimes under control of the delivery system itself. Rules and/or behaviors for navigation through an offering are established during content assembly.

Components of a delivery environment may include:
- Synchronous collaboration environments such as chat rooms, whiteboards, screen sharing, and audio or video conferencing,
- Asynchronous collaboration such as email discussion forums,
- Self-paced content (text, video, simulations, graphics, etc),
- Delivery and tracking of pre- and post-assessments, and
- Adaptive navigation, depending on the results of assessments.

Data on a learner's activities and status in an offering may be passed back to the learner profile.

**Offline Learning, Nomadic Learning, and Mobile Learning**

The ability to download standalone content and run it offline is a feature that allows e-Learning to occur in a disconnected environment. The delivery environment must re-synchronize content activity records when the learner reconnects. This is called offline learning by many e-Learning vendors in the US, whereas the term nomadic learning is popular in other English speaking countries. Mobile learning refers to using mobile devices (PDAs, cellular phones, etc.) as interfaces to a learning environment.

**Accessibility**

Student profiles can also provide accessibility requirement information that can be used to vary the delivery methods used for the learner. For example, hearing impaired learners
Collaborative Environment

Some e-Learning delivery systems are built almost exclusively around synchronous delivery and collaboration. They are called virtual classrooms because they try to extend the physical environment and interactions of a classroom to an online setting.

Although used for e-Learning, the technological approaches for virtual classrooms are quite different than those for Web-based course delivery environments aimed primarily at asynchronous delivery.

Assessment and Testing Engines

Assessment and testing may be integrated with learning content and delivered with it, or it may be managed as a separate process. In either case, assessment and testing are vital components of any educational environment and the storage, assembly, delivery, and recording of assessments is often handled by an independent component called an assessment engine.

Assessment engines typically include assessment authoring capabilities and can be used to create question banks from which assessments (and surveys) are assembled. The assembly process can include random selection of questions based on criteria and even the adaptive selection of questions based on previous results. The types of questions supported by assessment engines is impressively large, although straightforward multiple choice questions with a single correct answer still dominate.

2.4.5 e-Learning Product families

In the real world, the functions described above are typically spreaded across a number of tools and systems. Some common classes of products and product vendors, and the e-Learning functions they support are described as followed.

Learning Management System (LMS)

LMS is a term used primarily in the corporate market (such as NetDimensions EKP, Saba, and SumTotal). Full featured Learning Management Systems provide the following major
functions:

- Learner profile manager
- Learning offering catalog manager
- Learning planner
- Learner registrar
- Connection to delivery environment for delivery of learning offerings
- Delivery/participation tracking
- Assessment and testing tracking
- Assessment authoring tools
- Content assembler

In essence, they are intended to manage the learning environment, providing a place where content can be organized and presented to learners, learning plans can be managed, and where learning activities and results are tracked.

**Course Management System (CMS)**

This category of system is particularly prevalent in the education market where the focus of e-Learning is on blending a range of different learning delivery methods in an instructor-led environment. Course Management Systems differ from LCMS and LMS products in that they are intended for the template-driven assembly of entire courses and they integrate (although not always seamlessly) with student information or registrar systems. Typical CMS systems are WebCT, Blackboard, Sakai and Moodle.

Course management systems, such as those from eCollege, Blackboard, and WebCT, provide the following types of functionality:

- Assembly of course components into a curriculum with sequencing/navigation support,
- Delivery of course content to the learner,
- Electronic assignment management, submission, tracking, grading, and feedback,
- Creation and delivery of assessments, surveys, and tests,
- Integration of asynchronous tools such as discussion threads, moderated discussion, email group management, and document exchange,
• Integration of synchronous tools such as chat, whiteboard, screen sharing, audio conferencing, and video conferencing,

• Support for instructor management of courses including capabilities such as: dynamic revision of materials, assignment management, grade book, control over who can access the course, etc. and

• Automated tools to support integration with student administration systems for class scheduling, class enrollment, synchronizing student information, and results tracking.

Referring to the functional model above, these systems support the functions of the content assembler, catalog manager, learner registrar, delivery environment, collaborative environment, and assessment/testing engine. Given that several of these functions are also supported by learning management and student administration systems, the ability to integrate with these systems is a key to the successful use of a course management system.

**Learning Content Management System (LCMS)**

International Data Corporation (IDC) defines a learning content management system as a system that is used to create, store, assemble, and deliver personalized e-Learning content in the form of learning objects [IDC 2001].

The definition of an LCMS as a separate product family is a relatively new phenomenon. The level of sophistication around learning planning and tying offerings to business rules and business processes is far less in LCMS products than in LMS products, but the level of sophistication of content management and learning object management is far higher.

To support this interoperability across systems, new LCMS tools are designed to conform to standard specifications for content metadata, content packaging, and content communication.

A LCMS is a multi-user environment where learning developers can create, store, reuse, manage, and deliver digital learning content from a central object repository.

Whereas an LMS manages the processes surrounding learning, and LCMS manages the process of creating and delivering learning content, just as the names indicate.

The features of typical LCMS products include:
Content Assembly tools

Learning Content authoring tools may be included with the LCMS

Authoring tool integration that supports the registration, storage, and retrieval of objects by any standards-conformant authoring tool

A metadata-enabled content repository (including storage devices with some content management functionality and an offering catalog)

A simple learner profile manager, although these are becoming more sophisticated in LCMS products

A content delivery system that allows the LCMS to locate, retrieves, and serves up the appropriate objects to the delivery environment.

Many LCMS products integrate all of these components and are based on instructional design paradigms or instructional theories. Another tool found in some LCMS products is one for repurposing informal or legacy content, which in plain English means converting PowerPoint, or Word documents into learning objects that can be used by an LCMS.

With the development of e-Learning, more and more manufacturers invest in the field of LCMSs, such as Docent Enterprise, Galbraith Media, TopClass, TeraLearn, Knowledge Bridge and so on[Wang et al 2005].

The features and comparisons of CMS, LMS and LCMS are showed as Table 7.

Learning Portals

Learning portals bring together the e-Learning tools, content and delivery environment and organize them into logical groupings based on the role of the individual accessing the portal. Each organization using a portal will define and organize detailed roles based on their needs, but some common overall roles are content developer, instructor, advisor, administrator, and learner.

In the higher education space, schools implement these portals as an integral part of the school community and learning environment. Portal technology and services are available from a range of vendors including specialized vendors like Campus Pipeline, course management system vendors like WebCT, and Student Administration products such as PeopleSoft.
Table 7 The comparison of CMS, LMS and LCMS

<table>
<thead>
<tr>
<th>Feature</th>
<th>LMS</th>
<th>CMS</th>
<th>LCMS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Manage Learners</td>
<td>R</td>
<td>L</td>
<td></td>
</tr>
<tr>
<td>Manage Content</td>
<td></td>
<td>R</td>
<td>R</td>
</tr>
<tr>
<td>Create Content</td>
<td></td>
<td>L</td>
<td>R</td>
</tr>
<tr>
<td>Manages Instructor-led Sessions</td>
<td>R</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Course Catalogue</td>
<td>R</td>
<td></td>
<td>L</td>
</tr>
<tr>
<td>Registration System</td>
<td>R</td>
<td></td>
<td>L</td>
</tr>
<tr>
<td>Competency Management</td>
<td>R</td>
<td></td>
<td>L</td>
</tr>
<tr>
<td>Launch and Track eLearning</td>
<td>R</td>
<td></td>
<td>L</td>
</tr>
<tr>
<td>Assessment Creation, Evaluation, and Feedback</td>
<td>R</td>
<td></td>
<td>R</td>
</tr>
<tr>
<td>Searchable Library of Reusable Content</td>
<td>R</td>
<td></td>
<td>R</td>
</tr>
<tr>
<td>Collaboration / Synchronous Learning Tools</td>
<td></td>
<td>L</td>
<td>R</td>
</tr>
<tr>
<td>Integration with Human Resources Applications</td>
<td>R</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Locate and Deliver Specific Content to a Learner</td>
<td>R</td>
<td></td>
<td>R</td>
</tr>
<tr>
<td><strong>R = Robust Functionality</strong> <strong>L = Limited Functionality</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

(Adapted from Donelto, 2002 and Hall, 2003)

**Content Vendors**

In the academic space, particularly in higher education, publishers are making content available in most subject areas. They are repurposing their existing content for Web delivery as “course packs” or “cartridges” that run on widely used course management systems such as WebCT and Blackboard.

**Student Administration System**

In the higher education space, the learning management system functionality is provided by the integration of a course delivery management system such as WebCT or Blackboard with a student administration system such as those from PeopleSoft, SCT, or Datatel.

The student administration system manages the learner profiles, the offering catalog,
learner planning, and learner registration. The course delivery management system manages the content assembly, interacts with the authoring tools, supports learning delivery, and tracks detailed results.

**Authoring Tools and Assembly Tools**

Many authoring tools allow the incorporation of content created elsewhere via cut-and-paste. Content assembly tools do the same by treating everything as learning objects and combining them. Most content assembly tools are part of LCMS products, but some publishers and content development companies have produced tools that use relevant parts of SCORM (Sharable Content Object Reference Model) or AICC (Aviation Industry CBT Committee) standards as blueprints for creating learning content. These products may disappear in favor of more user-friendly versions, but the way they operate is by creating the structure of a course first and then filling out the structure with content.

**Assessment Engines**

Assessment engines provide specialized authoring tools designed specifically to create surveys, tests, and assessments. Most assessment engines also support the delivery of assessments to learners, and the reporting of results back to a learning management system. Some tools maintain their own database of results for reporting and analysis.

There are specialized assessment engines such as Question Mark or Quiz Studio that focus solely on the creation, delivery, and tracking of assessments. These specialized tools interoperate with a range of LMS, course management, and delivery environments.

### 2.5 Type of e-Learning interoperability standards

#### 2.5.1 Metadata

Content sits at the heart of e-Learning. Learning content and catalog offerings must be labeled in a consistent way to support the indexing, storage, discovery (search), and retrieval of learning objects by multiple tools across multiple repositories. Data used for this purpose is referred to as learning object metadata.

Several initiatives are creating metadata standards:
The IEEE Learning Technology Standards committee is in the process of accreditation of a standard called Learning Object Metadata, or LOM.

The IMS Global Learning Consortium, the Advanced Distributed Learning initiative, the Alliance of Remote Instructional and Distribution Networks for Europe, and many other organizations have adopted and adapted LOM.

The Dublin Core Metadata Initiative has a different metadata standard (used by libraries, publishers, government agencies, and other organizations) that also has an educational version. They are working closely with the IEEE to create a kind of umbrella for both standards so that each can be viewed as a special case of a common framework.

Educational Modeling Languages are emerging that describe the entire pedagogical methodology of a course. The IMS Learning Design team is trying to bridge the gap between high level and machine interpretable descriptions. All of this is in its nascent stages from a product perspective, but it may also be viewed as a form of metadata.

2.5.2 Content Packaging

Content packaging specifications and standards allow courses to be transported from one learning system to another. This is crucial since learning content can potentially be created by one tool, modified by another tool, stored in a repository maintained by one vendor, and used in a delivery environment produced by a different vendor. Content packages include both learning objects and information about how they are to be put together to form larger learning units. They can also specify the rules for delivering content to a learner. Some examples applying IMS Content packaging are listed as following [Wilson & Sarah Currier 2002]:

- The CO3 project investigated using IMS Content Packaging to exchange content between three VLEs: COSE, Colloquia and CoMentor.  
  http://cetis.bangor.ac.uk/co3/
- The MLE Interoperability Pilots in FE programme included projects focusing on content: http://www.jisc.ac.uk/mle/interop/
- The Exchange for Learning (X4L) Programme is focused on moving and exchanging
content, and includes projects using the IMS Content Packaging specification:
http://www.jisc.ac.uk/dner/development/programmes/x4l.html

- The DiLVLE Programme is concerned with linking Digital Libraries with VLEs, and will also contain projects that work with the IMS Content Packaging specification:
  http://www.jisc.ac.uk/pub02/c07_02.html

The initiatives dealing with content packaging include:

- The IMS Content Packaging specification (commercialized as LRN by Microsoft and supported by multiple vendors),
- The IMS Simple Sequencing specification (under development),
- Aviation Industry CBT Committee guidelines and recommendations for computer managed instruction (specifically their notion of a course structure file),
- The Advanced Distributed Learning initiative (ADL) Sharable Content Object Reference Model (SCORM), based in part on Aviation Industry work, and
- The IEEE Learning Technology Standards Committee, currently putting the Aviation Industry and SCORM work through the accreditation process.

Assessments and their component questions are a special kind of learning content currently supported by a different set of specifications. The end effect is the same: Questions, tests, and test banks may be created in one environment and used in a different one. The initiative most relevant to assessment packaging is:

- The IMS Question and Test Interoperability specification (QTI).

2.5.3 Learner Profile

Learner profile standards allow different system components to share information about learners across multiple system components. Learner profile information can include personal data, learning plans, learning history, accessibility requirements, certifications and degrees, assessments of knowledge (skills/competencies), and the status of participation in current learning.

Within the e-Learning standards community the most important efforts to standardize learner profile information are:

- The IMS Learner Information Package (LIP) specification,
• The Personal and Private Information (PAPI) specification that was originally an IEEE draft and is now being looked at by ISO.

In addition to the above two efforts, it could be argued that vCard, transcript exchange standards such as SPEEDE/Express, parts of the Schools Interoperability Framework (SIF), and parts of Human Resource staffing protocols such as those from HR-XML are essentially learner profile specifications.

2.5.4 Learner Registration

Learner registration information allows learning delivery and administration components to know what offerings should be made available to a learner, and provides information about learning participants to the delivery environment.

There are two initiatives currently dealing with these requirements in e-Learning:

• The IMS Enterprise working group has created a specification for exchanging offering and enrollment data among learning systems, and
• The Schools Interoperability Framework supports the exchange of this type of data in the K-12 environment.

2.5.5 Content Communication

When content is launched, there is the need to communicate learner data and previous activity information to the content. As a learner interacts with content, he generates some type of activity result, score or course grade. Course grades are often called completion status in the competency-driven corporate world. Sharing the launch, status of learning activities and results across multiple components of a learning environment requires standardization.

The standards being developed in this area allow components to share results at as low a level as an individual assessment question, or all the way up to a course grade or completion status. This is accomplished by creating standardized communication protocols and data models that allow learning content to communicate with the system that delivered it. Work is going on in two initiatives:

• The Aviation Industry CBT Committee. Their CMI (computer managed instruction)
specification includes a communication component, and

- The Advanced Distributed Learning initiative’s Sharable Content Object Reference Model (SCORM) project. SCORM 1.1 includes a JavaScript API for communication between a delivery system and the content it has delivered to a Web browser.

### 2.6 SCORM---An e-Learning reference model

SCORM is the ADL’s most widely known initiative. SCORM is a reference model (Figure 7) for standardizing the reusability and interoperability of learning content. Version 1.0 focuses on two critical pieces of learning content interoperability:

1. It defines a model for packaging learning content.
2. It defines an API for enabling communications between learning content and the system that delivers it.

SCORM also divides the world of learning technology into functional components. The key components are: Learning Management Systems (LMS) and Sharable Content Objects (SCOs). SCOs are a standardized form of reusable learning object. An LMS (for the purposes of SCORM) is any system that keeps learner information, can launch and communicate with learning objects, and can interpret instructions that tell it which object comes next. Additional components in the SCORM model are tools that create objects and assemble them into larger units of learning.

![Diagram of SCORM model](Source: Eduworks Corporation, 2002—www.eduworks.com)

Figure 7 The SCORM model
2.6.1 Content Aggregation

SCOs are self-contained units of learning. They can be used as building blocks to create packages of objects, but they cannot be broken down into smaller units. Three things must be done to create a larger unit of learning from objects.

1. The objects must be found and organized into a structure.
2. Instructions must be written that tell an LMS which object comes after which.
3. The objects and instructions must be bundled into a portable package.

This process is called content aggregation. Note that content aggregation includes instructions for moving between objects but not for movement within individual objects. SCORM has adopted a content packaging format from the IMS Global Learning Consortium. A SCORM package contains a manifest file that declares the contents of the package and is set up to describe the order in which the objects are to be delivered.

It also tells the LMS where to find the objects themselves. The physical resources represented by the object can be physically included in the package, or they can be referenced externally by the package.

2.6.2 Communicating with Content

The advantage of SCORM is that SCORM content can communicate learner information with any LMS using a standardized method based on JavaScript. The SCORM specification (which derives from work done by the Aviation Industry CBT Committee, or AICC) lays out exactly what pieces of learner information can be retrieved and updated. This information includes the learner’s name, the learner’s ID, scores on quizzes, time spent in a learning object, and the learner’s physical device preferences. This is a simple implementation that covers the basic requirements for communicating learner information.

In the SCORM model, content initiates all communication. When it is launched, it tells the LMS it has started. When it wants something from the LMS, it asks for it. When it wants to update learner information, it tells the LMS. And when it is finished, it tells the LMS it is finished. This passes control back to the LMS, and the LMS decides which object will be delivered next.
2.6.3 Metadata in SCORM

SCORM allows metadata to be included in every object and in every content package.

2.7 Trends and issues in e-Learning standards development

The following themes have guided much of the work in e-Learning standards bodies over the recently year.

2.7.1 Expansion of Content Specifications and Reference Models

e-Learning standards organizations are focusing heavily on learning content standards. The ultimate goal is a learning object economy characterized by searchable stores of reusable learning objects that can be assembled into adaptive units of learning and delivered by any learning system. However, the problems facing the e-Learning industry right now are basic questions of learning content interoperability.

2.7.2 Content Repositories

Having objects is not enough. One must also be able to store them, find them, and retrieve them. In recently years the standards communities have selected much of the infrastructure that will be used to build, connect, and enable searching across multiple digital learning object repositories.

2.7.3 Internationalization and Localization

Standards groups are active all over the globe and are increasingly eager to cooperate. This brings two challenges: that of creating culturally neutral standards (internationalization) and that of adapting standards to local needs (localization). Internationalization is addressed in part by ISO technical standards that need to be followed more closely by the e-Learning community. Vendors have planed to incorporate appropriate language and encoding standards. Cultural neutrality in standards that address metadata and instructional design is much trickier. Standards bodies are grappling with these issues and vendors can glean valuable information by participating in these deliberations.
2.7.4 Conformance and Compliance Testing

A major complaint about e-Learning standards is that products claiming conformance do not work together without further tweaking. This translates into lost time and expensive service engagements. As a result of this challenge, there is an increasing emphasis on developing conformance tests and certification programs. Expect to see certification programs for IMS, SCORM, IEEE, and other specifications and standards emerge in the coming year.

2.7.5 Architecture

e-Learning has grown organically without a clear picture of the components of a typical e-Learning system or how they interrelate. The need for such architecture is critical for defining competitive arenas and for standards development. Expect standards bodies to make progress toward an overall architecture in near future.

2.8 Open source and open standard

2.8.1 What is Open Source?

Open source refers to software’s source code that is freely available to anyone who wishes to extend, modify, and improve the code. Some examples of open source projects are Linux, Apache, Mozilla, and OpenOffice.

The GNU project (http://www.gnu.org) defines free software as “a matter of the users’ freedom to run, copy, distribute, study, change and improve the software.” Particularly, attention is given to four freedoms. They are:

- The freedom to run the program, for any purpose (freedom 0).
- The freedom to study how the program works, and adapt it to your needs (freedom 1). Access to the source code is a precondition for this.
- The freedom to redistribute copies so you can help your neighbor (freedom 2).
- The freedom to improve the program, and release your improvements to the public, so that the whole community benefits (freedom 3). Access to the source code is a
precondition for this.

The open source model encompasses a set of principles and values that ensure the integrity of open source software. Open Source Initiative (http://www.opensource.org), a not-for-profit organization has proposed 10 items that are widely accepted by the open source community. These items are:

1. Free redistribution
2. Source code must be included
3. Derived works – allow modifications
4. Integrity of the author’s source code
5. No discrimination against persons or groups
6. No discrimination against fields of endeavor
7. Distribution of license
8. License must not be specific to a product
9. License must not restrict other software
10. License must be technology-neutral

It is delineated several benefits of open source software. They are as follows[Coppola and Neelley 2004]:

1) The software evolves more rapidly and organically.
2) Users’ needs are rapidly met as the Open Source Software (OSS) model harnesses their collective expertise and contribution.
3) New versions are released very often and rely on the community of users and developers to test it, resulting in superior quality software tested on more platforms, and in more environments than most commercial software.
4) The development “team” is often largely volunteers, distributed, many in numbers, and diverse. Often, paid members of the development team will manage the project and organize the work of the volunteers.
5) Security is enhanced because the code is exposed to the world.

Open source models, by nature, mandate informal formation of communities of practice in which individuals are bond together with common sense of problems working toward common pursuit of solutions. Communities of Practice are not teams. A community of
practice is a group of individuals that are informally bound to collaborate on a shared task. These individuals are peers with a common sense of purpose that are working together to accomplish real tasks. It is described as a community of practice in three dimensions [Wenger 1998]:

1) what it is about – its joint enterprise as understood and continually renegotiated by its members
2) how it functions – mutual engagement that bind members together into a social entity
3) what capability it has produced – the shared repertoire of communal resources (routines, sensibilities, artifacts, vocabulary, styles, etc.) that members have developed over time.

Furthermore, we believe that the open source model promotes collaboration and sharing of resources globally. It creates a community of people that work together to achieve common goals. And sometime it reduce the digital divide between the developed and developing country, As said by Andrew Leonard: “Open-source software has been called many things: a movement, a fad, a virus, a Communist conspiracy, even the heart and soul of the Internet. ...But one point is often overlooked: Open-source software is also a highly effective vehicle for the transfer of wealth from the industrialized world to developing countries”[Wong & Sayo 2004]. So it will promote the IT development and acting as a key to the door of IT education in the Chinese HEIs.

2.8.2 Open Source and e-Learning

In the past several years, higher education institutions have initiated the creation of enterprise open source applications such as course management systems and electronic portfolios. These e-Learning applications initiatives are initial steps higher education is taking to move away from proprietary software toward open source. With open source, higher education institutions can easily and freely audit their systems. The systems become open, transparent, and flexible and this reduces the vendor lock-in. There will be ultimate access/control, ownership, and freedom. The open system encourages increased exchange of ideas that advances innovation. It is stated that anyone can use open source software,
however; successful implementation of open source model depends on [Young 2004]:

1) Community building,
2) Agreeing on a common definition of open source,
3) Allocating and securing budget for “free” software,
4) Encouraging institutions to switch to open source,
5) Have a positive working relationship with companies.

It is suggested that open source model promotes freedom to choose, increases user access/control, encourages link to a global community, promotes quality, and enhances innovation in teaching and learning [Coppola and Neelley 2004].

The e-Learning movement toward open source model has been evident in the recent years. There are many open source projects dedicated to e-Learning. Below is a list of several selected organizations that are involved in helping instructor to build their e-Learning courses:

- Claroline (http://www.claroline.net)
- .LRN Course Management (http://www.collaboraid.biz/products/dotlrn)
- EduZope (http://www.eduzope.org)
- Moodle (http://moodle.org)
- Pachyderm (http://www.nmc.org/projects/lo/pachyderm.shtml)
- Sakai (http://www.sakaiproject.org)
- Spaghetti Learning (http://www.spaghettilearning.com)
- A Tutor (http://www.atutor.ca)

### 2.8.3 Open Source and Learning Objects

Learning objects are small pieces of instruction that are granularized and reused in various instructional contexts. Learning objects are stored in repositories. Through a repository, learning objects are accessed and reused in various instructional contexts.

There are many open source websites that offer free learning objects. Below is a list of selected organizations that are providing free learning objects:

- Apple Learning Interchange (http://ali.apple.com/ali/resources.shtml)
- CAREO (http://careo.netera.ca)
- Distributed Learning Object Repository Network (DLORN) (http://www.downes.ca/cgibin/dlorn/dlorn.cgi)
- Educational Object Economy (http://www.eoe.org)
- Educational Software Components of Tomorrow (ESCOT) (http://www.escot.org)
- Filamentality (http://www.kn.pacbell.com/wired/fil)
- Gateway to Educational Materials (GEM) Project (http://www.thegateway.org)
- MERLOT (http://www.merlot.org/Home.po)
- Open Course (http://opencourse.org)
- OpenCourseWare (MIT) (http://ocw.mit.edu/index.html)
- Universitas 21 Learning Resource Catalogue (LRC) (http://www.edlrce.unsw.edu.au)
- Wisconsin Online Resource Center (http://www.wisc-online.com)

In 2005, the Informing Science Institute (http://www.informingscience.org) has announced that it is developing an open resource learning object repository – ISLO (http://www.islo.org). Creators of learning objects can submit their products to the ISLO repository. The learning objects in the repository are accessed by anyone around the world. The unique aspect of this repository is that it will not only allow peer review of learning objects, but also it will allow the communities of practice to extend, modify, and improve learning objects within the repository.

2.8.4 Open Source and Open Standards

The basis for open source model is the open distribution of the source code. In other words, anyone can examine, modify, change, and improve the source code. Open standards form the foundation for product interoperability [Vento, 2004]. Interoperability is the ability of the product/software to move around multiple platforms. Interoperability ends the product dependency on a specific platform. It allows a product to operate/function in multiple platforms with different protocols and technologies.

Open standards ensure interoperability that is critical to any distributed e-Learning system. The open source community, therefore; must implement open standards in creating open source e-Learning systems. Outlined below are several models of open standards:

- IEEE LO Metadata (LOM) Learning Technology Standards Committee (LTSC)
3. A pilot experiment

3.1 Student-centered teaching and e-Learning environment

In brief, the Student-Centered approach is based on the hypothesis that students who are given the freedom to explore areas based on their personal interests, and who are accompanied in their striving for solutions by a supportive, understanding facilitator not only achieve higher academic results but also experience an increase in personal values, such as flexibility, self-confidence and social skills. This approach, also known as experiential learning, requires specific personal attitudes on the side of the instructor who takes over the role of a facilitator. These attitudes are highly transparent, open communication, positive regard towards students and the seeking for deep understanding [Rogers 1983; Aspy 1972].

While the positive effects of the “pure” Student-Centered approach have been proved in a number of case-studies and are well-documented in the literature [Rogers 1983; Baxter 2001; Chase 2001; Gamboa 2001], its combination with the Internet as a resource for acquiring knowledge and as a medium for supporting communication is a novel asset. This combination is referred as Student-Centered e-Learning (SCeL) [Motschnig-Pitrik 2002].

In Motschnig-Pitrik’s work it is argued that, due to the fact that the Internet opens up vast knowledge and communication sources, it largely frees the “instructor” from acting as a pure knowledge transmitter. It thus provides room for personal and group processes in the presence phases and thereby optimally supports Student-Centered Teaching, being directed towards learning as a whole person including intellect as well as feelings, also known as
experiential learning. SCeL is particularly well suited to support, small teams of students who cooperate on a project each by contributing his/her special knowledge and skills [Ryback 1998]. These groups and their members can follow their individual work styles, stay in their preferred locations and work environments and nevertheless share documents freely on the web such as to stay up to date in their cooperative work. In fact, all course participants unanimously appreciated the convenient access to their shared documents, allowing them to coordinate their cooperative project work between the presence phases and use the latter for discussion, presentation, feedback, etc.

From the Motschnig-Pitrik’s point of view it became apparent that SCeL requires communicative and social skills that are very different from the qualifications needed for conducting traditional courses. Generally speaking, the case study led to the hypothesis that the Student-Centered Approach grows in effectiveness with respect to deepening learning- and teaching processes, in the case that:

- Sufficient amounts of material are electronically available (e-Content). More precisely, the material could as well be otherwise easily available, such as in the form of books and journals, although, in our experience, availability in electronic form proved most versatile and time effective.
- Instructors, preferably facilitators hold the personal attitudes necessary for providing a constructive learning climate can communicate these attitudes [Rogers 1961] and have advanced social- and communicative skills.
- All participants succeed in employing the computer and Internet as a resource for significant parts of knowledge transfer as well as for some aspects of communication and organization.

Xian Jiaotong University (XJTU) Computer Teaching and Experiment Center (CTEC) is a department in charge of most of the computer related course for all the non-IT major undergraduates in the university. The main courses cover computer programming, network, multimedia technologies, computer literacy, Management Information System (MIS). Except the computer literacy (A compulsory course for all the freshman in the university), all the other courses are selected by most schools in the university based on their own needs and evaluations.
Back to the year 2003, a case study involving IT courses for the undergraduates in Xi’an Jiaotong University in networking and web application requirements was performed to assess the relevance of combining Student-Centered Teaching with the use of the Internet. The original model was developed by the well-known American psychologist Carl Rogers (1902 – 1987).

In particular, we are interested in finding whether a customized version of Student-Centered Teaching would fit into our traditional curriculum in the university and the related grading system.

From our point of view, our practice emphasizes in the teaching reform toward the student centered learning, and uses the e-Learning platform as an important tool for management, so we describe our practice as Student-Centered Teaching assistant by e-Learning platform or SCeT.

SCeT is a new way in our teaching practice, It has the following requirements:

- Suitable lab resources
- Open lab environment
- Effective communication means

### 3.1.1 Suitable lab resources

The characteristics of so-called suitable lab resources include:

- Up-to-date and may help in student’s future career(e.g. all the application software we used in the course were published within 1-2 years);
- Available to all the students and fruitful in the limited period of the semester(e.g. most of the software we used in the course could be found in http://www.sourceforge.org, so the student can learn from the open source software, even take part in their development);
- Provide sufficient techniques or space for student to explore by themselves;
- The teacher may give advice based on their experience;
- No violation of user condition or copyright problem (Because Free/open source software are free for use, distribution, copy, modification etc, so there is no concern of pirate problems in the teaching and learning processes.).
3.1.2 Open lab environment

The Open lab environment means that the student can visit the related lab environment from any location and at any time, if it can be accommodated. We encourage students to access the lab resource at their wills. For example, after the course, the lab environment can be maintained for those students with intention to do research in the vacations and continue their study.

3.1.3 Effective communication means

The effective communication includes the interaction of teachers and students and between the classmates as well. It can be E-mail, forum, ICQ or associated websites. But, the most powerful means is course management system (CMS); CSM can be used as a portal for IT courses.

Besides its register, access logs, course forum, lecture notes announcement, assignment delivery and feedback, quiz management and grade book functions, the lab resources and the lab outcome can be displayed or linked to the platform as well. Thus the learning and experiment platform for SCeT is formed.

One beneficial by-product of the CMS platform is that all the content in the system can be retrieved, backup or recovered easily. It will provide the means to continue evaluation, reusing and exchanging the education process.

Since Xian Jiaotong university(XJTU) Computer Teaching and Experiment Center(CTEC) has developed the various network resources(include applications for lab work, various lab guides, Internet based experiment and websites for student project exhibition) , so in our course, we primarily adopted OSS (Open Source Software) course management system (Moodle) as the portal for our course, to integrate all the learning resources necessary for the course, to increase course management efficiency, convenience for students to access, as well as the SCeT activities. In our view, this experiment not only provides the instructor a great experience in the higher education practice, but also fosters the students to be critical thinkers and learners, and appreciate experience to use e-Learning---it might become a lifelong learning means for most of them.
The e-Learning system structure diagram for our Scet course is shown below (Figure 8).

![Diagram of e-Learning system structure](image.png)

Figure 8 e-Learning environment in CTEC@XJTU

3.2 Design and evaluate patterns for collaborative e-Learning in the IT courses

In the MIS course instruction of 2003 academic year, we tried adopting student centered teaching in the lab part of the course, encouraging students to build prototype portal for enterprise, and using Moodle to manage the whole teaching and experiment process.

In the course’s lab part, the students voluntarily formed of 3-5 persons group, and chose website developments project (Other projects could be chosen as well, such as the investigation of information technique used in the business enterprise). Because the web page design and programming is not the preceding course for those students, lacking the website developments ability became a main difficulty to complete the project. So we recommended the OSS Content Management System (e.g. Postnuke) to construct the prototype website as their course project.

During the course, besides the publishing platform, which we built for the student’s websites publishing, a course management system (CMS)---- OSS Moodle was introduced
for improving the efficiency of the message exchanges between teacher and the students and management all the teaching process. The changes of the teaching mode not only brought challenge to students, but also requested the instructors and the tutors pay more of time and attention on the course. At the end of the course, feedback and results proved the value of teaching reform.

However, while practicing the reform, the SCeT was restricted by a few aspect:

1) Course outline, syllabus and the teaching contents (particularly those classroom contents) are scheduled, the instructor were not expected to change that. Generally, SCeT is difficult to keep consistence with our usual syllabus (the content was limited and all the process details were arranged);

2) The inertia of student learning style. In the most of the undergraduates’ learning experience, they are accustomed to follow the teacher’s teaching arrangement and the freedom left for student to study in China education system is usually limited: Once given the option of studying on their own, quite a large part of students felt confused, or failed to explore the learning resource given by the instructor;

3) Lacking of teamwork spirit, in the SCeT process, social skill is usually an important factor to success. But quite a few students lack the cognition and experiences of teamwork. As a result the efficiency of team cooperation was low, communication is far from being enough, or the team existed in name only. There even were quarrels some time – in the collaboration process.

4) The evaluation method of learning result, generally the HEIs in China, compare with the western countries, put the great emphases on the end exam. But SCeT should put the emphases on the process evaluation, the main factor of the success of teaching. Because “Continuous cooperation that is traceable by special programs and Web-based self- and peer evaluation make final tests and exams superfluous in many cases. Final meetings with students or small teams tend to be used more strongly to reflect on the whole course experience and personal learning, based on self- and peer evaluation, than on recalling course content[ Motschnig-Pitrik, R., & Mallich, K. 2004].”
5) In general, although SCeT give the greater freedom of study to student, but on the instructor’s side, he/she should pay more effort in organizing the learning resources, environment and the continue evaluation (And normally no direct reword or impel from the administration to encourage the reform), this is why most instructors in the HEIs do not take the new way to instruction.

Based on the considerations mentioned above, we decided to put the practice of SCeT on the Lab part of the IT courses in our campus, the reasons include:

- IT evolves fast, so does the lab works in the syllabus. This is the main and important objective demand for us to conduct SCeT; at the same time, we can pay respect to the curriculum in the face-to-face environment.
- Undergraduates in our campus, are with various backgrounds, so do their IT literacy levels. A few excellent students may exceed the instructor’s expectation. Those kinds of wisdom and ability (most of the students willingly to share those with their classmates) provided SCeT with the subjective condition;
- It is provided SCeT with the suitable environment that the popularity of Internet, WWW and search engine technique, especially the free software and open source software providing the SCeT with enriched learning resource.

As long as the teacher takes the first step, pushed the ball begins to roll, it is easy for students to follow the blended teaching paradigm. As part of the returns of the SCeT, some lab project works could be accumulated to be the learning cases for next semesters. The students are beneficial from the experience and achievement, the instructors are beneficial from their career satisfactions and much more (The reform fruits harvested from both of the instructors experience and student projects, as we develop the IT courses as sustainable teaching platform, some student will continues to use it as their own interesting even after graduated from the university. So that provides the vivid examples for the following students (see http://202.117.35.70/~b1111020/ and http://202.117.35.70/wue/).

3.3 The comparison of SCeT with traditional way

In the SCeT course, we reformed the MIS course lab contents. The original lab content
requests for the student master UML or the Rational ROSE application, in the process of system analysis and design description.

In the SCeT, the student will have many more choices to select design websites, explore advanced applications (such as MS Project for Meeting planning, Imagine Extend for transaction process simulation, etc), practice the various WWW based Content Management System(Such as Postnuke for enterprise portal, SugarCRM for Marketing, etc)or compose an IT relevant thesis(see Figure 9).

![MIS course user interface of the experimental CMS for student](image)

Figure 9 The MIS course user interface of the experimental CMS for student

The SCeT approach to content delivery and task completion was very different from the usual approach in the courses under study. Table 8 tabulates these differences.

<table>
<thead>
<tr>
<th>No.</th>
<th>Item</th>
<th>Usual way</th>
<th>SCeT way</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Lab/project time consumption</td>
<td>Mainly arranged in the lab time by teacher</td>
<td>Mainly arranged in the spare time by students themselves</td>
</tr>
<tr>
<td>2</td>
<td>Lab/Project selection</td>
<td>By the teacher</td>
<td>Consult by teachers and students</td>
</tr>
<tr>
<td>3</td>
<td>Process control</td>
<td>By the teacher</td>
<td>By the students, the teachers inspected periodically</td>
</tr>
<tr>
<td>4</td>
<td>Lab resource</td>
<td>Provided by the teacher</td>
<td>Part provided by the teacher, part from students’ own selection</td>
</tr>
<tr>
<td>5</td>
<td>End evaluation</td>
<td>By the teacher</td>
<td>By teachers and peer students</td>
</tr>
<tr>
<td>6</td>
<td>Content guide</td>
<td>By the teacher</td>
<td>By the teacher and student, and the later were strongly encouraged</td>
</tr>
<tr>
<td>7</td>
<td>Motivation</td>
<td>The students in a passive statue</td>
<td>The students were kept with the contents of interest and worked on themselves with their own initiative</td>
</tr>
<tr>
<td>8</td>
<td>Arranged lab time</td>
<td>Teacher directs the students to</td>
<td>The teacher checks the student project process, help students to</td>
</tr>
<tr>
<td>9</td>
<td>Lab form</td>
<td>Learning by Individual</td>
<td>Learning and proceeding mainly in groups</td>
</tr>
<tr>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>10</td>
<td>Evaluation methods</td>
<td>End exam 70%, lab and assignment 30%</td>
<td>End exam 50%, lab and assignment 50%</td>
</tr>
<tr>
<td>11</td>
<td>infrastructure</td>
<td>The Internet as a resources and assignment delivery platform</td>
<td>CMS—Moodle as important course management tool, improves integration of the course resources, enhance teachers and the students communicate efficiency, reducing teacher work strength in long term, because most of contents and settings in Moodle are reusable, can be easily backup from past semester’s CMS and recovered or released in new semester’s, just part of the course contents (like references or web links) might be need to check or change.</td>
</tr>
</tbody>
</table>

### 3.4 Student feedback

In traditionally predominated higher school, the impact of SCeT exceeded our expectations. The feedbacks from the students include:

- The student willingly to choice their missions in the lab, particularly with those of realistic meaning, they would like to invest more time and enthusiasm;
- Most of student were willing to take part in teamwork, with the expectation for mutual complement (Because in the WWW site construction process, many “technical know how” are needed, such as site and web page design, dynamical page programming, data collection, site testing, document preparation and project coordination etc. but no enough proceeding course for them as a whole, what can do is divide the work, learn by themselves and cooperation). They mentioned in their final reports when the teamwork started, the various uncomfortable experience they encountered. but at the end, all of those team members felt having gained greater experience than those who did solo;
- Students were more delight to take part in the works that efforts will be covered in evaluation system, aware of that the final grade will contain those part as well;
- Students’ study attitude had significantly changed, once they are aware of being trusted and respected, they will be more willing to cooperate, show more accountability, and even be constructive;
• With much more time and energy to invest than the other courses or labs, the students are more willing to share happiness and success with each others, some even feel displeased because we have no time left to arrange for them making a public exhibition, and subsequently announce in the forum for their viewpoint and feelings.

4. Investigation and analysis

In the past decade many universities, or in particular university faculties, have conducted the development and deployment of a course management system (CMS) [Kamrat et al. 2002, Hines et al. 2000, Ullery 2002]. Their goals are:

• to improve traditional educational processes and to define new classroom strategies by creating more effective active learning situations;
• to introduce a viable tool for learners and managers of learning (professor, teaching collaborators, faculty advisors, principals…) in order to build an effective e-Learning community, i.e. a cohesive unit which is of better knowledge management in educational programs.

The mere introduction of a CMS in an educational organization does not guarantee the achievement of the above mentioned goals; anyway, there is strong evidence that its wide deployment and fully usage are strictly necessary conditions to build an e-Learning community [Panel on the Impact of Information Technology on the Future of the Research University 2002].

The purpose of our experiment is to find the benefits or otherwise of developing and providing a subject resource online for campus students studying IT course at Xi’an Jiaotong University. The development of such a resource web page is wide spread in Chinese HEIs, yet there seems to be little research in to the benefits or drawbacks of providing such a resource.

The origin of the investigation topic was a desire by the author to provide an online management course resource for CTEC@XJTUI’s IT course students. It was envisaged this resource would act as a management tool of IT course, but more importantly, it became a source of practical, applied information theory and pedagogy reform. The reason for such an
approach was to improve the students’ ability to apply theory learned in class (especially for those MIS course students).

In the beginning, we anticipated a lot of problems those we might encountered during the pilot experiment, they include:

- The stability and the scalability of the e-learning system (Moodle);
- How can the instructor who is lack of experience use the e-learning system?
- If the students who are lack of experience in e-Learning can accept the course management system as an assistance tool?
- What kind helps that the e-Learning system can offer?

But, it is certain that the integration of web-based learning components with system such as Moodle brings added value to traditional education. Students and faculty benefit from using the communication and assessment tools. Students have a customized approach to knowledge acquisition that suits learning styles and busy schedules. Continual access to resources through online delivery and automated management tools minimize the faculty’s cost and time associated with the experience.

So, this study was based on some of junior students (the third year classes) in Xi’an Jiaotong University, studying for a Management Information System course.

The analysis component of the study is focused on:

1) The usability of the e-Learning platform;
2) The performance of the students using e-Learning platforms a resource versus the students use the conventional Internet resources only;
3) The students’ thoughts and opinions on e-Learning platform;
4) The pedagogy related with e-Learning platform.

### 4.1 Methodology

#### 4.1.1 Aims and objectives of the experiment

One of the main objectives is to examine the benefits or otherwise of the provision of IT course using Moodle as a subject resource. This subject resource is designed as assistant tool to empower management of IT course process and evaluation. At the design stage both,
quantitative and qualitative methods of data capture and analysis was considered. It was felt that the qualitative approach might give an insight into the student’s perceptions of Moodle. However, there was a danger that it would lack clear focus. The quantitative approach was seen to be adequate and appropriate, as it would yield actual numerical data. Therefore it was decided to use the quantitative approach as the main method, with some qualitative feedback from each student.

4.1.2 Profile of the CTEC@XJTU and Its Students

The Computer Teaching and Experiment Center in the Xi’an Jiaotong University is a lab in charge of the Computer and IT foundation course for all the university’s undergraduates. Its courses cover Computer foundation, Program design, PC principle and interface application, Computer network, Management Information System, etc. All the students (about 6000 per year) who attend CTEC’s courses come from about 20 schools in the university.

CTEC have built a 1G switch LAN in the lab and about 30 various servers on Windows NT, Linux, and Novell operating system, and provide WWW, E-mail, FTP, Assignment, Exam and other services. About 600 PCs is located in 9 labs, Four of the labs are open access areas to students, which allows students to enter the labs 8:00am to 10:00pm, Monday to Sunday, to work on projects etc. most of the PCs in the CTEC’s Labs can access the domestic networks or sites (because the Internet fee’s budget limitation of the university) via a 1G optical fiber.

All students have some experience with personal computers. Computer Applications is a compulsory subject where they receive 10 hours of basic IT lab experience. This includes Word Processing, File management, Database, Internet usage and Spreadsheets. As a result none of the students required instruction in basic Windows or browser skills. Also these students already had a computer culture with the use of personal computers being part of their daily lives (actually all the student dormitory are network connected).

A typical course in CTEC includes classroom lecture and lab, the ratio usually is about 1:1. For example, MIS for social science students gets 32 lectures plus 32 hours lab work that expected to be processed within 16 weeks of the academic semester. The students are taught the material using traditional teaching techniques, chalk and talk plus computer
projector, questions and answers and homework exercises. Some network resources are advisable for all the faculty and students to share including: FTP server for distributing lecture notes and assessment delivery, web site for Q&A and BBS, etc. But all the resource is discrete, no LMS is used to organize and manage the learning process.

### 4.1.3 Selection of CMS

The experiment was based on the realization of CMS and it aimed to build an e-Learning environment at the CTEC@XJTU. The development strategy was to make an open system, with the following main features, available:

- **Accessibility.** It should provide an easy-to-use interface for supporting classroom activities through synchronous and asynchronous connections inside and outside the class time;
- **Adaptability.** It should be able to respond to different requirements arising from many learning course scenarios;
- **Extensibility.** It should enable one to integrate new learning services, to add and modify tools, layouts, and so on, while the e-Learning community evolves, and new needs are rising.

A requirement analysis was firstly carried out to ensure the understanding of the target e-Learning community. Users were grouped in three main classes: technical system developers/administrators, teaching managers (professor, teaching collaborators, faculty advisors, principals…) and learners.

Apart from standard administration functions and developing tools (access management, users enabling, templates configuration...), we identified the following basic functionalities:

**For learning managers:**

- classroom lifecycle online management;
- asynchronous messaging and communication management (public agenda, bulletin board...), repository management of digital teaching material (slides, documents, quiz test, etc.);
- threaded discussion forum management about classroom topics,
investigation/survey management to collect feedback from students;

- assessment tools to measure efficiency and effectiveness of online teaching activities.

For learners:

- Download of documents and multimedia course material;
- Read access to announcements on bulletin board and on shared calendar;
- Two way interaction (synchronous and asynchronous mode) with teachers thru messaging system and threaded forums;
- Self-evaluation test;
- FAQ about system features and course activities;
- Integrated search engine for courses information retrieval.

Three basic possible strategic directions were taken into account in order to create a starting CMS:

- Adopting a ready-to-go commercial solution; since source code is not available, such commercial system has low flexibility and poor extendibility; moreover, the integration with legacy software and existing IT-infrastructure might be problematic;
- Developing from scratch a system that perfectly fits all specific requirements; this strategy is very expensive in term of resources and time. In addition to that, it requires a team of good experienced developers that is not always available in a faculty environment;
- to adopt a semi-ready open-source software system (OSS) to be successively customized, configured and extended by adding new components or modules.

The third one is widely recognized to be the most suitable solution that can match both low cost investments and fully application customization [Kaderali & Elhert 2003]. Besides, some Chinese government initiatives are currently devoted to support OSS usage in education and this has strengthened our motivation towards the use of an OSS.

Before the experiment, no formal CMS is use in the Xi’an Jiaotong University scope, so some OSS platforms of course management were evaluated under this perspective. Finally, our choice was to join the Moodle, [http://moodle.org]. Moodle platform is based on PHP server
side script language and it is available in many languages (simplified Chinese included), it needs a very simple architecture based on the most famous open-source web server (Apache) and a well-known open-source DBMS (MySQL). The interface is very light and can be accessible easily from any browser (Internet explorer, mozilla, opera). New modules and new features are continuously added as they become available from active developer members and they are tested by debuggers. The modularity of Moodle let local developers/administrators modify and easily adapt the source code to their particular organization context. The moodle is fully compatible to current Internet standard (XML, SCORM) for the best integration with the existing infrastructures.

4.1.4 Deployment and customization

Starting from the packaged version of Moodle, the idea was to make a ready-to-go prototype based on its original version which is immediately available, but with minor customizations to fit our specific requirements:

- Registration and authentication of learners are based on their university registration number as a unique key (because e-mail system restriction, most of learner can not complete the online registration, so we changed to use patch registration by name list instead)
- Enabling procedure for registration of instructors and their account validation
- Add course categories and arrange the courses content for them (At the beginning, we load all the teaching and lab materiel into the CMS, include the PPT, Word, PDF and even some applications, at the end of the semester, it is found that the backup is huge; so we changed it that all the teaching and lab materiel is put on the FTP server, on the hyperlink of the materiel show in the course board of the Moodle)
- News module to prompt course announcement and some other general information in home page

The firstly released packages were configured to run on MS Windows and, lately, were ported in more stable Redhat Linux environment. Some example picture of the MIS course and the Moodle site at CTEC are as follow:

All the courses can be organized in category and arranged with different access
permission, such as open to all visitors, open to the registered students only, or open to the visitor with course access key (Figure 10).

![Figure 10](image)

*Figure 10 The homepage for the a Moodle site in CTEC*

In the course screen, the top block (Figure 11) can include:

- Syllabus
- Course forum
- Course links
- Course reference
- Project news and online demonstration

![Figure 11](image)

*Figure 11 The top block of MIS course in the Moodle environment*

In the week arrangement (Figure 12), the content is organized as the curriculum required:

- Content digest
- Lecture Note (usually is a PPT file)
- Assignment

75
● Reference material
● Quiz
● Glossary

Figure 12 A typical week arrangement for the MIS course

The calendar (Figure 13) acts as a reminder for student about:

● Assignment delivery time
● Quiz arrangement
● Project check point

Figure 13 The calendar is helpful for student to do the course works

The course forum (Figure 14) is the main channel for teacher and student, student and student communication, the Moodle forum is support file and picture attachment (it seems very simple today, but in the main course BBS developed for CTEC at 2000, only text is allowed to be posted on, that will be difficult for student to illustrate the GUI type problems).
The glossary (Figure 15) function in Moodle is helpful for bi-lingual course.

The assignment module (Figure 16), the assignment control and feedback is convenient for instructor to work with and the score of the assignment can be integrated in to the gradebook of Moodle. But as to the large class as up to 100 students, the screen roll operation became a weary work.

The quiz mould (Figure 17) in Moodle is fascinating for the instructors. It not only can be used to edit the quiz on line (Figure 18), and also can import quiz in text file that is adhere some quiz format of CMS (Figure 19). And it can be used to do investigation as well. All the result and some primary statistics can be exported as a excel file (Figure 20) and integrated.
in to the grade books of Moodle.

![Figure 17 The quiz interface for student](image1)

![Figure 18 Quiz editing interface for the teacher](image2)

![Figure 19 The Moodle can accept quiz files from several standards of famous CMS](image3)

The standards of the quiz file include:

- WebCT
- Blackborad
- ...
Figure 20 The quiz statistical can be acquired in the excel format

The backup and recover function (Figure 21) can be used for achieving the teaching material and course content reuse, they are implement in XML format, so the content backup in one Moodle environment can be recovered in the next semester on another.

Figure 21 The recover function interface

4.2 Research Design

Up to now, the discussions, or even knowledge, about e-Learning from the student perspective seem to be very sparse even in developed counties. However, there are reports of students overwhelmingly preferring to take class using e-Learning than traditional course. They felt that e-Learning was a helpful tool in their learning [Brotherton & Abowd, 2002]. Some study explores e-Learning in higher education seen from the students’ point of view. It discusses their attitudes to and experience of e-Learning used in regular university training programs. The focus is on e-Learning in such programs used as a supplement to teacher-controlled tuition on campus [KELLER &CERNERUD 2002].

Students’ perceptions of e-Learning in university education may be influenced by
specific individual factors (Such as did student come from city or countryside? The student’s family background is rich or not (were his/her parents jobless)? The IT knowledge of the student is fair or not (Were he/she no touching the keyboard until enter the university)? What kind of the learning styles the student may have, does he/she prefer Lab then classroom teaching?). In Chinese HEIs, There are at least three such characteristics: computer literacy, individual learning style, and affordability.

In P.R. China, even the computer foundation or computer culture is listed as a compulsory course, the university undergraduates have a great diversity of computer literacy, and the main reason comes from the great diversity that exists in the secondary education with conditions different in urban and rural area.

Individual learning styles play an important part in adapting to new learning situations. Individuals differ in their general skills, attitudes and preferences for processing information, constructing meaning from it, and applying it to new situations [Jonassen & Grabowski, 1993]. Hence, individuals would react and adapt differently to e-Learning depending on their individual learning style. In the Chinese tradition, the notions like “teacher is respectable”, and “Teacher is the center of education” has a long history, students might be confused in the e-Learning and SCeT.

The affordability is a problem the developing country must to face. e-Learning will consume much more computers, network or lab resources than the traditional course. The “digital divide” exists even in the Chinese research universities. It will be unfair for those students who can not afford being kept out the door of e-Learning.

In the process of the experiment, it is recognized that e-Learning is not just to move the lecture note and assignment on line. The more important issue might be the potential by the pedagogy reform to adapt the e-Learning environment to foster the competence of the learner.

In our investigation, we put two types of questions on line (use the Moodle Quiz function): one is rank form, and another is multiple choice. The former type is designed to get the data for correlation analysis, and the later for locating the main problem that exists in the learning process.

Our research used online questionnaires to collect the responses of a thirty-six student
sample to twenty-one questions on factors assumed to affect student performance in the CTEC course. Fifteen of these questions used a five-point Likert scale, suggesting responses “strongly disagree” to “strongly agree”. The questionnaires also ask the students to express their opinions on the effect of e-Learning and SCeT.

We collected the statistical results as listed in Table 9. The questions in the questionnaires were arranged in several blocks (see appendix):

Questions numbers 1~2 is a basic condition for e-Learning, question number 1 for the student computer literacy self estimation (not the grade in Computer Literacy), and question number 2 is an investigation of the “digital divide” that is existing in most (if not all) Chinese HEIs.

Questions numbers 3~7 is an investigation to the student learning styles or preferences, namely, by lecture, (arranged) Lab, e-Learning (by CMS), peer communication, Internet.

Questions numbers 8~9 investigate student understanding of the lab project and teamwork.

Questions numbers 10~11 investigate student e-Learning involvement and Time devoted to the SCeT.

Questions numbers 12~14 investigate student gains in the SCeT in three aspects, IT improvement, Confidence in IT self-learning, and Teamwork output.

Questions number 15 investigates to the student’s consideration on the SCeT comparison with usual IT course lab teaching.

All the 15 Likert-type 5 points scale questions ranked as shown in appendix, so it is possible for us to analyze the correlation between all the investigation item. Questions numbers 1~12 is treated as a present set of conditions, learning styles, attitudes, etc, the question number 13~15 are treated as the a result set from the SCeT course. What we concern most, is which of items in the present set will correlate with those items in the result set. The Statistical results of responses to the questionnaire as showed in the Table 9.

In the research, we focus on two hypotheses:

\[ H1: \text{Students with good computer literacy background will be more involved in e-Learning.} \]

\[ H2: \text{Students who are appreciating e-Learning and SCeT have got IT skill improved greater.} \]
Simple correlation (Pearson) analysis is used to determine if there is any significant correlation between the investigation items. A Windows version of the statistical package, SPSS 10.0 package was used.

Table 9 Statistical results of responses to the questionnaire

<table>
<thead>
<tr>
<th>No.</th>
<th>Investigation item</th>
<th>Strongly agree(5)</th>
<th>Agree(4)</th>
<th>Disagree/agree(3)</th>
<th>Disagree(2)</th>
<th>Strongly Disagree(1)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Computer literacy</td>
<td>0</td>
<td>16.6%</td>
<td>75.0%</td>
<td>8.3%</td>
<td>0</td>
</tr>
<tr>
<td>2.</td>
<td>Network conditions</td>
<td>38.8%</td>
<td>30.5%</td>
<td>25.0%</td>
<td>5.5%</td>
<td>0</td>
</tr>
<tr>
<td>3.</td>
<td>Lecture</td>
<td>25.0%</td>
<td>36.1%</td>
<td>30.5%</td>
<td>8.3%</td>
<td>0</td>
</tr>
<tr>
<td>4.</td>
<td>Lab</td>
<td>11.1%</td>
<td>47.2%</td>
<td>36.1%</td>
<td>5.5%</td>
<td>0</td>
</tr>
<tr>
<td>5.</td>
<td>E-Learning as a means</td>
<td>41.6%</td>
<td>38.8%</td>
<td>19.4%</td>
<td></td>
<td>0</td>
</tr>
<tr>
<td>6.</td>
<td>Peer communication</td>
<td>27.7%</td>
<td>41.6%</td>
<td>27.7%</td>
<td>2.7%</td>
<td>0</td>
</tr>
<tr>
<td>7.</td>
<td>The Internet</td>
<td>13.8%</td>
<td>44.4%</td>
<td>38.8%</td>
<td>2.7%</td>
<td>0</td>
</tr>
<tr>
<td>8.</td>
<td>Project select</td>
<td>19.4%</td>
<td>63.8%</td>
<td>2.7%</td>
<td>11.1%</td>
<td>2.1%</td>
</tr>
<tr>
<td>9.</td>
<td>Teamwork necessary</td>
<td>47.2%</td>
<td>38.8%</td>
<td>11.1%</td>
<td>2.7%</td>
<td>0</td>
</tr>
<tr>
<td>10.</td>
<td>E-Learning involvement</td>
<td>13.8%</td>
<td>36.1%</td>
<td>36.1%</td>
<td>11.1%</td>
<td>2.7%</td>
</tr>
<tr>
<td>11.</td>
<td>Time devoting</td>
<td>13.8%</td>
<td>47.2%</td>
<td>30.5%</td>
<td>8.3%</td>
<td>0</td>
</tr>
<tr>
<td>12.</td>
<td>IT Improvement</td>
<td>11.1%</td>
<td>72.2%</td>
<td>16.6%</td>
<td></td>
<td>0</td>
</tr>
<tr>
<td>13.</td>
<td>Confidence</td>
<td>5.5%</td>
<td>55.5%</td>
<td>27.7%</td>
<td>11.1%</td>
<td>0</td>
</tr>
<tr>
<td>14.</td>
<td>Teamwork output</td>
<td>16.6%</td>
<td>38.8%</td>
<td>33.3%</td>
<td>11.1%</td>
<td>0</td>
</tr>
<tr>
<td>15.</td>
<td>SCeT Confirmation</td>
<td>16.6%</td>
<td>72.2%</td>
<td>11.1%</td>
<td></td>
<td>0</td>
</tr>
</tbody>
</table>

4.3 Empirical analysis

4.3.1 Testing of Hypothesis 1

The student computer literacy is measured in terms of the student’s self-estimation. The e-Learning involvement is rated on the activities, such as “send post and ask question” was rated as 5, and “no used basically” was rated 1. The correlation result is shown in Table 10(altogether 36 samples):
Correlation analysis shows that there is no direct relationship between computer literacy and e-Learning involvement. However, there are some points that worth noticing.

1) A good student's computer literacy background seems to have not much positive impact on the IT course leaning (the trend is negative correlation with face-to-face lecture and arranged labs even toward e-Learning although not significant, and in fact those students may be often absent in class and lab). There is also no direct relationship between computer literacy and their opinions on their IT skill improvement. In view of both result, it would be more appropriate to claim that there is no direct relationship between computer literacy and the e-Learning involvement.

2) There is a close correlation between those who appreciate face-to-face lecture and those who appreciate arranged lab and e-Learning means. From our point of view, it is mainly the inertia of traditional IT course pedagogy that most of the students are accustomed to. However, most of the students in university nowadays are media savvy, so they also welcome the e-Learning means used in the course. But no direct correlation is found between any of the traditional teaching or e-Learning means and IT skill improvement, it indicates that any single means would not directly affect the

Table 10 Statistical test for computer literacy and e-Learning involvement

<table>
<thead>
<tr>
<th></th>
<th>Computer Literacy</th>
<th>Lab</th>
<th>e-Learning</th>
<th>e-Learning Involve</th>
<th>IT Improvement</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Correlations</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Correlation</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Computer literacy</td>
<td><strong>Pearson</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sig. (2-tailed)</td>
<td>1.000</td>
<td>-.020</td>
<td>-.144</td>
<td>-.276</td>
<td>.034</td>
</tr>
<tr>
<td>N</td>
<td>35</td>
<td>35</td>
<td>35</td>
<td>36</td>
<td>36</td>
</tr>
<tr>
<td>Lecture</td>
<td><strong>Pearson</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sig. (2-tailed)</td>
<td>-.020</td>
<td>1.000</td>
<td>.529**</td>
<td>.426**</td>
<td>.310</td>
</tr>
<tr>
<td>N</td>
<td>35</td>
<td>35</td>
<td>35</td>
<td>36</td>
<td>36</td>
</tr>
<tr>
<td>Lab</td>
<td><strong>Pearson</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sig. (2-tailed)</td>
<td>-.144</td>
<td>.529**</td>
<td>1.000</td>
<td>.488**</td>
<td>.160</td>
</tr>
<tr>
<td>N</td>
<td>35</td>
<td>35</td>
<td>35</td>
<td>36</td>
<td>36</td>
</tr>
<tr>
<td>e-Learning</td>
<td><strong>Pearson</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sig. (2-tailed)</td>
<td>-.276</td>
<td>.436**</td>
<td>.488**</td>
<td>1.000</td>
<td>.164</td>
</tr>
<tr>
<td>N</td>
<td>35</td>
<td>35</td>
<td>35</td>
<td>36</td>
<td>36</td>
</tr>
<tr>
<td>e-Learning Involve</td>
<td><strong>Pearson</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sig. (2-tailed)</td>
<td>.034</td>
<td>.310</td>
<td>.160</td>
<td>.164</td>
<td>1.000</td>
</tr>
<tr>
<td>N</td>
<td>35</td>
<td>35</td>
<td>35</td>
<td>36</td>
<td>36</td>
</tr>
<tr>
<td>IT Improvement</td>
<td><strong>Pearson</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sig. (2-tailed)</td>
<td>.233</td>
<td>.206</td>
<td>-.051</td>
<td>-.110</td>
<td>.108</td>
</tr>
<tr>
<td>N</td>
<td>35</td>
<td>35</td>
<td>35</td>
<td>36</td>
<td>36</td>
</tr>
</tbody>
</table>

**Correlation is significant at the 0.01 level (2-tailed).**
SCeT’s result, e.g. the introduction on e-Learning won’t automatically promote the teaching and learning quality

3) There is a close correlation between those who appreciate the arranged lab and e-Learning, from our point of view, it is because most of the students were used to the Moodle in the lab time, do a lot of assigned work, such as download file, complete quiz, delivery assignment and browse the course forum etc.

4.3.2 Testing of Hypothesis 2

Use the same measurement in determining the impact of e-Learning in the SCeT as a whole. Students were asked about their learning style to see if they accepted the SCeT pedagogy as a new way of learning. The factors considered include:

1) Acceptance of SCeT as basic learning concept
2) Acceptance of e-Learning as a new platform to communicate
3) Acceptance of peer communication as a important way in “whole person” learning
4) Students plan for their future profession. They select the real and related problem as their lab project
5) Students know the importance of teamwork skill in their future profession
6) Student’s time invested on their selected project when compared with traditional IT course lab.
7) The factor may have direct impact to IT skill improvement.

As shown in Table 11, Correlation analysis shows that there is no direct relationship between confirmation on SCeT, e-Learning and IT improvement. But, those students who are appreciating SCeT may devoting more time on their course project, and the time devoting factor which is highly correlated with IT skill improvements. This implies that only those who have a sound understanding on the SCeT, selected the project of career implication, communication by peer or e-Learning fluently, devote the time much more than the traditional arranged lab, will improve their IT skill greater.
### 4.4 The T-tests

#### 4.4.1 The t-test for the relation of face-to-face lecture and e-Learning

To test the relationship between those who prefer the face-to-face lecture and their preference toward e-Learning mean, we use question 3 (see appendix) as a key to draw the line between students who are accustomed to notes and lectures and students who are not. The result is shown in Table 12 below.

**Table 12 The Group Statistics by learning style preference**

<table>
<thead>
<tr>
<th>Learning</th>
<th>N</th>
<th>Mean</th>
<th>Std. Deviation</th>
<th>Std. Error Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>e-Learning</td>
<td>&gt;= 4</td>
<td>22</td>
<td>4.50</td>
<td>.74</td>
</tr>
<tr>
<td></td>
<td>&lt; 4</td>
<td>14</td>
<td>3.79</td>
<td>.58</td>
</tr>
</tbody>
</table>

**Table 13 The Independent Samples Test by learning style preference**

<table>
<thead>
<tr>
<th>Learning</th>
<th>Levene's Test for Equality of Variances</th>
<th>t-test for Equality of Means</th>
<th>95% Confidence Interval of the Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>e-Learning</td>
<td>Equal variances assumed</td>
<td>Equal variances not assumed</td>
<td></td>
</tr>
<tr>
<td></td>
<td>F</td>
<td>Sig</td>
<td>t</td>
</tr>
<tr>
<td></td>
<td>2.476</td>
<td>.125</td>
<td>3.059</td>
</tr>
<tr>
<td></td>
<td>3.232</td>
<td>32.402</td>
<td>.003</td>
</tr>
</tbody>
</table>
We can see that over 60% of respondents either agree or strongly agree that face-to-face lectures are important way of learning IT course. We then try to divide the students into two groups. The ones who agree or strongly agree that face-to-face lectures are most effective are classified as students that are accustomed to the tradition way of learning. Others are put in another group that is open to learning in the new way. We then come to analyze the level of acceptance of these two groups to the concept of e-Learning. As shown in Table 13, the value of t is 3.059 with two tailed significance of 0.004. Therefore there is significant difference of the preference for e-Learning between those that are accustomed to face-to-face lectures and those that are not.

4.4.2 The t-test for the relation of e-Learning appreciation and involvement

To test the relationship of e-Learning appreciation and involvement, we use question 10 (see appendix) as a key to draw the line between students who are involved in e-Learning deeper or shallower. The result is shown in Table 14 below.

Table 14 The Group Statistics by e-Learning involvement

<table>
<thead>
<tr>
<th>e-Learning involvement</th>
<th>N</th>
<th>Mean</th>
<th>Std. Deviation</th>
<th>Std. Error Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>&gt;= 4</td>
<td>18</td>
<td>4.28</td>
<td>.67</td>
<td>.16</td>
</tr>
<tr>
<td>&lt; 4</td>
<td>18</td>
<td>4.17</td>
<td>.86</td>
<td>.20</td>
</tr>
</tbody>
</table>

Table 15 The Independent Samples Test by e-Learning involvement

<table>
<thead>
<tr>
<th></th>
<th>Levene's Test for Equality of Variances</th>
<th>t-test for Equality of Means</th>
</tr>
</thead>
<tbody>
<tr>
<td>e-Learning</td>
<td>df</td>
<td>Sig</td>
</tr>
<tr>
<td>Equal variances</td>
<td>34</td>
<td>.151</td>
</tr>
<tr>
<td>Equal variances not</td>
<td></td>
<td></td>
</tr>
<tr>
<td>assumed</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

We can see that 50% of respondents either post question or browse the forum often. We then try to divide the students into two groups. The ones who either post question or browse the forum often are classified as students who accept e-Learning as an important of learning. Others are put in another group that is not so active in the new way. We then come to analyze the level of acceptance of these two groups to the concept of e-Learning. As shown in Table 15, the value of t is .433 with two-tailed significance of 0.667. Therefore there is no significant difference in the two groups. It gives the conclusion that one appreciate the
e-Learning as an effective way of learning but may not involve in the e-Learning activities for various reasons.

4.4.3 The t-test for the relation of IT skill improvement and the cognitive of SCeT

To test the relationship of IT skill improvement and the cognitive of SCeT, we use question 15 (see appendix) as a key to draw the line between students who appreciate SCeT or not. The result is shown in Table 16 below.

**Table 16 The Group Statistics by SCeT confirmation**

<table>
<thead>
<tr>
<th>IT improvement</th>
<th>SCeT confirmation</th>
<th>N</th>
<th>Mean</th>
<th>Std. Deviation</th>
<th>Std. Error Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>&gt; = 4</td>
<td></td>
<td>32</td>
<td>4.03</td>
<td>47</td>
<td>8.38E-02</td>
</tr>
<tr>
<td>&lt; 4</td>
<td></td>
<td>4</td>
<td>3.25</td>
<td>50</td>
<td>24</td>
</tr>
</tbody>
</table>

**Table 17 The Independent Samples Test by SCeT confirmation**

<table>
<thead>
<tr>
<th>IT improvement</th>
<th>Levene’s Test for Equality of Variances</th>
<th>t-test for Equality of Means</th>
<th>95% Confidence Interval of the Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Equal variances assumed</td>
<td>F: .404, Sig: .529, df: 34</td>
<td>t: 3.092, df: 34, Sig (2-tailed): .004, Mean Difference: .78, Std. Error Difference: .25</td>
<td>Lower: .27, Upper: 1.29</td>
</tr>
<tr>
<td>Equal variances not assumed</td>
<td>F: 2.903, Sig: 3.708, df: 3.706, .046</td>
<td>t: 3.78, df: 3.706, Sig (2-tailed): .046, Mean Difference: .78, Std. Error Difference: .26</td>
<td>Lower: 2.58E-02, Upper: 1.54</td>
</tr>
</tbody>
</table>

We can see that 89% of respondents appreciate SCeT. We then try to divide the students into two groups. One is who appreciate SCeT as students who understand the means of SCeT pedagogy. Others are put in another group that is not so clear about SCeT. We then come to analyze the level of improvement of these two groups to the IT skill. As shown in Table 17, the value of t is 3.092 with two-tailed significance of 0.004. Therefore there is significant difference in the two groups. We get the conclusion that one appreciates and understand the means of SCeT and work on the course can get their IT skill improved.

4.5 Some findings and discussion

In this experiment, e-Learning as a supplement to the on-campus education in China HEIs, some points may be noted and discussed:

1. e-Learning is a way for the instructor to teach students in accordance to their aptitude.

Because IT development provides an efficient way to evaluate the student learning characteristics, so the instructor can dividing the students into different categories, so we can encourage the students to use their own advantage in the collaboration learning or project proceeding, to complement and learn from each other in learning group.
2. e-Learning should be introduced as early as possible to HEIs students. Although it is the first time for those students to be introduced the e-Learning platform, over 80% of them admitted that it is “very important” or “important” in the current course learning process, and over 70% consider it is useful in their life-long learning. But the involvement of those students is quite shallow, only 13.8% of those students post questions on the Moodle. It is observed that very few students were active to answer questions. The reason for that could be:

- The passive learning attitude remains the main stream for those students (about 70% of those students just view the forum or download martial regularly and never post or upload anything);
- Unfamiliarity with the e-Learning platform (some of the students could not post their lab problem clearly or correctly);
- The lack of community or teamwork consciousness. Some of the team had little communication in the group or among classmates.
- The “third year” problems, under pressure like job seeking, taking exam for graduate program or going abroad, the third year undergraduates in the HEIs would shift their focus from the course to their long term targets, in the investigation at least 25% of those students admitted that they “got other more important things to do, so the time devoted to the course study the course was not enough.”

All the facts reflect that it is necessary to introduce e-Learning in the early stage of the undergraduate education. The best way is to combine it with the computer literary or foundation course in the first year, together with learning community and collaborating consciousness fostered, if it is possible.

The limitation of the study includes:

- Restrained by Accessibility, non commercial CMS is adapted for comparison;
- The samples size is small.

In our view of point, if the result of the hypothesis analysis being of representative is not important, because the students’ IT background is varied; The thing of importance is that the CMS provides a much easier way to conduct the survey and the model established in the dissertation to do the analysis works and is operable even by the instructor individuals.
5. Conclusion and further research directions

The development of e-Learning can be compared to the development of plastic. When plastic was introduced some decades ago, its designers wanted it to be a substitute for wood, so they designed it brown with a wood grain pattern. The first plastic devices looked poor, worse than the wood they were trying to replace. Later on, its look improved, because it was no longer used as a poor replacement for wood, but for completely new and innovative purposes and to the plastic’s own advantages [Clark Aldrich, cited in fortune 2000]. E-Learning was – and still often is – an attempt only to replace common education or training scenarios with the hope to save money and time [Anderson (2000a)]. Learning content was (and is) migrated to new media without changes.

One result of this attempt is reflected in some incomplete e-Learning definitions. They only cover the delivering of learning content via electronic channels. Still missing is a very important link between the two components “content” and “technology”: didactics or pedagogies. From various papers and documents which talk about e-Learning and the investigation result in our research, we can observe that e-Learning it could not be the silver bullet to promote the education quality of the HEIs, but it provides a powerful means to introduce and develop advanced pedagogies. It is the very need of the Chinese HEIs especially the Chinese research universities that they are facing the huge pressure from the state administrator and the public media.

Further research of e-Learning in Chinese HEIs could include:

- Study the strategy for e-Learning implementation in Chinese universities or higher education sector. Since there is OKI project in America universities, it is a strategy base on the community to developing an open source or community source e-Learning standards; Some EU universities adapt open source e-Learning project as a prototype do developing. Of course, the commercial solution is also a way to do it. Chinese higher education sector or the key universities will consider the solution suitable for themselves.

- Study evolution the evaluation method toward teaching in the higher education sector, to encourage the instructor to invest their time and talent in teaching and
use IT or e-Learning as an effective means in their teaching so as to drive the universities focus on promoting the education quality, especially for ten millions undergraduates in the Chinese HEIs.

- Study the mechanism related with e-Learning support, and how to maintain a quality and sustainable e-leaning program, it will include ROI analysis, solution planning, instructor training, technological support and content developing or acquisition. Salter, Richards and Carey [2004] bring up the T5 (Tasks, Tools, Tutorials, Topics and Team work) model as an instructional model and learning environment to support the integration of online and campus-based courses is of great inspiration for us to develop an operational process sustainable for campus e-Learning.

- In developed countries, e-Learning is popular in the higher education sector, and under being extended to K12 schools. But, in China, it is at the initial stage even in the higher education sector, so it is worth to note the problems being encountered in the e-Learning by Chinese youth because of their unique culture background.

As a pilot experimenter, it is notable in our view that a good e-Learning strategy could maximize technology to enhance the teaching and learning process. As Internet access is becoming a given in most of the Chinese HEIs, competition among universities will be on the quality of the learning experience: quality online learning programs supported by online information, administrative, and technical support services.

It is said that “Procrastination and inaction are dangerous courses for colleges and universities during a time of rapid technological change, although institutions will also need to avoid making hasty responses to current trends. Just as in earlier periods of change, the university will have to adapt itself to a radically changing world while protecting its most important values and traditions, such as academic freedom, a rational spirit of inquiry, and liberal learning [Panel on the Impact of Information Technology on the Future of the Research University 2002].”

Though our practice, it is clear that the Chinese HEIs are possible to value the e-Learning means by utilizing OSS CMS to promoting campus education quality and it is the time now.
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## Appendix

### e-Learning and SCeT Questionnaire

<table>
<thead>
<tr>
<th>No.</th>
<th>Question</th>
<th>Investigation item</th>
<th>Strongly agree (5)</th>
<th>Agree (4)</th>
<th>Disagree/agree (3)</th>
<th>Disagree (2)</th>
<th>Strongly Disagree(1)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>我的计算机操作技能在此课程之前就__________________?</td>
<td>Computer literacy</td>
<td>很好 (very good)</td>
<td>好 (good)</td>
<td>一般/同意 (fair)</td>
<td>否定 (poor)</td>
<td>否定 (very poor)</td>
</tr>
<tr>
<td>2.</td>
<td>我的计算机及网络使用条件（如宿舍有计算机、可借用同学计算机、可自费上机）(My Computer and network Accessibility is ___________________)?</td>
<td>Network conditions</td>
<td>很好 (very good)</td>
<td>好 (good)</td>
<td>一般/同意 (fair)</td>
<td>否定 (poor)</td>
<td>否定 (very poor)</td>
</tr>
<tr>
<td>3.</td>
<td>本课程我获取信息系统知识的途径中，课堂教学对我__________________?</td>
<td>Lecture</td>
<td>极为重要 (very important)</td>
<td>重要 (important)</td>
<td>一般/同意 (fair)</td>
<td>否定 (not too important)</td>
<td>否定 (not important)</td>
</tr>
<tr>
<td>4.</td>
<td>本课程我获取信息系统知识的途径中，课程上机过程对我__________________?</td>
<td>Lab</td>
<td>极为重要 (very important)</td>
<td>重要 (important)</td>
<td>一般/同意 (fair)</td>
<td>否定 (not too important)</td>
<td>否定 (not important)</td>
</tr>
<tr>
<td>5.</td>
<td>本课程我获取信息系统知识的途径中，e-Learning平台对我__________________?</td>
<td>e-Learning</td>
<td>极为重要 (very important)</td>
<td>重要 (important)</td>
<td>一般/同意 (fair)</td>
<td>否定 (not too important)</td>
<td>否定 (not important)</td>
</tr>
<tr>
<td>6.</td>
<td>本课程我获取信息系统知识的途径中，电子教室对我Peer communication is__________________?</td>
<td>Peer communication</td>
<td>极为重要 (very important)</td>
<td>重要 (important)</td>
<td>一般/同意 (fair)</td>
<td>否定 (not too important)</td>
<td>否定 (not important)</td>
</tr>
<tr>
<td>7.</td>
<td>本课程我获取信息系统知识的途径中，网友间的沟通或搜索引擎对我The Internet is__________________?</td>
<td>The Internet</td>
<td>极为重要 (very important)</td>
<td>重要 (important)</td>
<td>一般/同意 (fair)</td>
<td>否定 (not too important)</td>
<td>否定 (not important)</td>
</tr>
<tr>
<td>8.</td>
<td>我对需要自行选择实验项目，感到In my view, selecting project by myself to the learning is__________________?</td>
<td>Project select</td>
<td>极有必要 (very necessary)</td>
<td>有必要 (necessary)</td>
<td>一般/同意 (fair)</td>
<td>否定/困惑 (confused)</td>
<td>否定 (Hard to choice)</td>
</tr>
<tr>
<td>9.</td>
<td>我对需要进行团队合作，感到In my view, teamwork is__________________?</td>
<td>Teamwork</td>
<td>极有必要 (very necessary)</td>
<td>有必要 (necessary)</td>
<td>一般/同意 (fair)</td>
<td>否定/困惑 (confused)</td>
<td>否定 (Hard to choice)</td>
</tr>
<tr>
<td>10.</td>
<td>电子教室中的活动，我参与的主要有In the e-Learning platform, mainly I__________________?</td>
<td>e-Learning involvement</td>
<td>发帖子, 提问题 (post question)</td>
<td>浏览学习论坛的内容 (browse the forum)</td>
<td>一般/同意 (fair)</td>
<td>否定/困惑 (confused)</td>
<td>否定 (Hard to choice)</td>
</tr>
<tr>
<td>11.</td>
<td>我在这门课程的实验项目上所花费的课外时间，比同类的课程实验要In the SCeT, my time devoting is__________________?</td>
<td>Time devoting</td>
<td>多一份以上 (one time more than usual way)</td>
<td>多 50%以上 (50% more than usual way)</td>
<td>一样 (same)</td>
<td>少 20%以上 (over 20% less than usual way)</td>
<td>50%以上 (over 50% less than usual way)</td>
</tr>
<tr>
<td>12.</td>
<td>在参与了本课程实验项目后，我的计算机操作技能有了After SCeT, my computer skill is__________________?</td>
<td>IT Improvement</td>
<td>显著提高 (improved greatly)</td>
<td>提高 (improved)</td>
<td>一般/同意 (fair)</td>
<td>否定 (no improvement)</td>
<td>落后 (lag behind)</td>
</tr>
<tr>
<td>13.</td>
<td>在参与了课程实验项目后，我对自学计算机及信息系统操作的信心After the SCeT, my confidence on IT self-learning is__________________?</td>
<td>Confidence</td>
<td>大大加强 (improved greatly)</td>
<td>加强了 (improved)</td>
<td>一般/同意 (fair)</td>
<td>否定 (not improved)</td>
<td>完全放弃 (total give up)</td>
</tr>
</tbody>
</table>
14. 我对我们项目组团队合作的效果感到(As to the Teamwork output, I am _______)?

<table>
<thead>
<tr>
<th>Teamwork output</th>
<th>很满意 (very satisfied)</th>
<th>满意 (satisfied)</th>
<th>一般 (fair)</th>
<th>不满意 (not very satisfied)</th>
<th>很不满意 (not satisfied)</th>
</tr>
</thead>
<tbody>
<tr>
<td>我们项目组团队合作的效果</td>
<td>满意</td>
<td>满意</td>
<td>一般</td>
<td>不满意</td>
<td>很不满意</td>
</tr>
</tbody>
</table>

15. 我认为本课程这种实验课学习方法对学习信息技术比以往的(In my view, the SCeT is _______ than usual lab teaching)?

<table>
<thead>
<tr>
<th>SCeT Confirmation</th>
<th>优越的多 (Much better)</th>
<th>优越 (better)</th>
<th>一样 (same)</th>
<th>效果更差 (not as good as old way)</th>
<th>无法适应 (hard to adapting)</th>
</tr>
</thead>
</table>