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Knowledge Building in E-Learning

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1. Introduction

With the rapid development of information society and wide spread of life-long learning, the needs for knowledge are growing dramatically. With the fast pace of modern life, most people cannot afford to take formal courses in the classroom. Therefore, more and more people turn to distance learning for its flexibility in time and space. Different from face to face learning, both the learners and tutors can resort to information technology to facilitate communication and information transfer. As PCs become popular and the bandwidth increases, e-Learning has gained major popularity among the learners. Consequently, a well-designed and sophisticated online learning environment can stimulate learners to learn, simplify the learning process, facilitate deeper comprehension and increase collaboration, which can contribute not only to the growth of learners' knowledge, but also to the improvement of learning and communication capability. The annual report of Online Education in the United States demonstrates that 29.3% of the students at colleges or universities in the United States chose online education. Accordingly, the attention by the scholars to the changes in the learning modes, resource building and sharing, platform design and maintenance and instructional or curriculum reform that the internet brings forth is constantly increasing. However, the studies concerning the influence of new technology environment on knowledge building is relatively weak. What are the changes in knowledge acquisition, representation and application in the web environment taking place? How to conduct knowledge service in on-line learning with remarkable performance? How would cloud computing and cloud services affect learners' knowledge building? This paper made efforts to analyze knowledge building in on-line learning regarding four aspects including knowledge engineering, knowledge services, cloud computing and cloud services against the background of developing theories of knowledge in order to provide guidance promoting online education.

The remainder of this paper is organized as follows. Section 2 describes the development of knowledge theories; Section 3 discusses the knowledge engineering and knowledge building in on-line learning; Section 4 describes knowledge services and knowledge building in on-line learning; at the last section we presents our future work directions.

2. The development of knowledge theories

The theories of knowledge, as the basic opinions from people on knowledge are related to the whole understanding and basic views of knowledge including hypotheses and beliefs of

the nature, attribute, value, standard, paradigm and validity of knowledge. The theories of knowledge are not knowledge itself but people's ideas and retrospection of knowledge during the process of gaining, enriching and growing knowledge. Considering the development of contemporary theories of knowledge, the evolution of the theories comprises of Rationalism, Empiricism, Pragmatism, Constructivism and Post modernism among which the first four types of theories belong to modern views of knowledge while the later refer to "Post-modernism".

2.1 The modern theories of knowledge

In view of the modern theories of knowledge, knowledge is "the understanding of property and relations, which is shown as psychological patterns including perceptions, presentations, definitions and rules" (Shi Zhongying, 2001).This view is created in 17 century with philosophical bases including Rationalism, Empiricism and Pragmatism.

Rationalism regards knowledge as objective existence independent of subjects without any link to the object of knowing. In addition, knowledge can only be acquired through people's rational activities. Opposed to Rationalism to a certain extent, Empiricism holds that knowledge originates in sense experience. All knowledge is empirical, which in essence emphasizes the psychological level of the individual's sense experience. This view affected American Pragmatism substantially. However, Pragmatism differs from Empiricism on the point that Pragmatism attaches emphases to the behavioral level of individual's behavior, believing that knowledge is the tool of behaviors. Knowledge should be examined through experiments to be known as truth or fiction (Thomas • E • Hill, 1989). The essence of instruction does not lie in the knowledge injection but in rebuilding experience.

Although a great number of differences found among the three theories, they all bear the characteristics of objectivity, universality and neutrality. The objectivity of modern knowledge refers to that knowledge correctively reflects the nature of objects or the essential and necessary link between objects. Universality means that the objective statements of knowledge can be accepted beyond various social and individual limitations. Neutrality indicates that knowledge is the product of pure experience and reason. Knowledge is "culture-free" or "value-free" since it is only related to the property and ability of objects' knowing.

2.2 Post-modern theories of knowledge

Dating back to 1960s, the development of information technology brought about profound changes in modes of production, styles of life and concepts of culture. The industrialized society has transferred into the information society moving towards the knowledge society which encourages knowledge innovation and aims to cultivate innovative and creative elites. During the process mentioned above, people have introspected the objectivity, universality and neutrality pursued by modernists. Criticism that inheriting the modern theories of knowledge from Rationalism and Empiricism, the pursuit of objectivity and certainty leads to authoritarian and hierarchicality of knowledge and partial understanding and abuse of reason ending with superstition and desperation of scientific knowledge were raised. Constructive theory of knowledge and post-modern theories of knowledge have pointed out critical comments on the issues mentioned.

Constructivists with broad views of knowledge regard sociability, contextuality, constructivity, complexity and implicity as central elements of knowledge. The main views of constructivism are mainly divided into individual constructivism and social constructivism.

The Swiss cognitive psychologist Jean Piaget is the founder of individual constructivist theory of knowledge. In his view, knowledge is generated neither from objects nor subjects but from the interactions between objects and subjects——"activities" . Children construct their knowledge about the external world through the process of interacting with the environment in means of assimilation and accommodation, which develops their cognitive structure. In addition, Piaget opposes the idea that knowledge is "input" with his view that the new and old experience of children colliding with each other initiates changes in concepts and reconstruction in frameworks with a process of assimilation and accommodation.

The Social Constructivism represented by the Soviet psychologist L.S.Vy-gotsky emphasizes the crucial rule "interpersonal communication" and "social-cultural environment" play in knowledge construction. Learners' interaction and communication with society are valued. Furthermore, the theories and practice of social constructivism are displayed by Ontario Institute for Studies in Education, University of Toronto. Scardamalia and Bereiter(1994) maintain that knowledge is not the truths stored in human brains. It is created collectively through group discussion, which is not just as an assemblage of individuals' knowledge. The process of building knowledge is modifying and updating the collective knowledge. The aim of knowledge building is to form public knowledge of certain value for the learning community rather than simply increasing the content of individual's brain. Given the core of learning is how to facilitate learners to be knowledge builders, the increase of content in individuals' brain is one of the byproducts of learning.

The constructivism generated new meaning experiencing the wave of post-modern education. Doll (Doll, W.) at the *Louisiana* State *University, USA* pointed out that knowledge is not absolute, objective but uncertain. Knowledge is not universal but contextual. Knowledge is not neutral but valuable. Knowledge is not unique but diverse. Based on his thoughts, a new post-modern theory of knowledge has been built. Doll opposes the idea of the modern theories of knowledge that knowledge is a meaning system that could be investigated from the outside for the reason that it is the objective reflection to reality, closed and stable in his book A *Post - Modern* Perspective on Curriculum. In his view, knowledge is the interpretation of the dynamic, open self-adjustment system which is within the system (William E. Doll, 1993).

Above all, the Post-modern views of knowledge mainly demonstrate the cultural, contextual, valuable, diverse elements of knowledge. Highlights have been made that knowledge is the information and its construction through interaction between individuals and environment. Knowledge encompasses the storage and retrieval means of knowledge as well as the application and transmission routes. The Post-modern views of knowledge reveal the independent relation between individuals and the environment and the nature of knowledge as information. They further point out openness as the characteristic and value of application and transmission, which meets the trend and goal of economy and science development as updates based on retrospection and critics on modern views of knowledge.

2.3 Knowledge building in on-line environments

Knowledge building refers to a process of creating and improving valuable thoughts for the community as an integral part of spreading cultural advancement through increasing the possibility of the situation that what the community has realized is larger than assemblage of individual contribution. The concept was raised by Marlene Scardamalia and Carl Bereiter from the Ontario Institute for Studies in Education, University of Toronto, in 1987. They maintain that knowledge is not the truth stored in individual's brain but collective knowledge that is created collectively through learners' group discussion. The collective knowledge is larger than the assemblage of individual's knowledge. Moreover, the process of knowledge building is modifying and improving the collective knowledge. What distinguishes knowledge building and the traditional instructional practices significantly is that traditional instruction normally focuses on how an individual acquires knowledge while knowledge building pays more attention to students' spiritual state of learning and collective knowledge's proceeding.

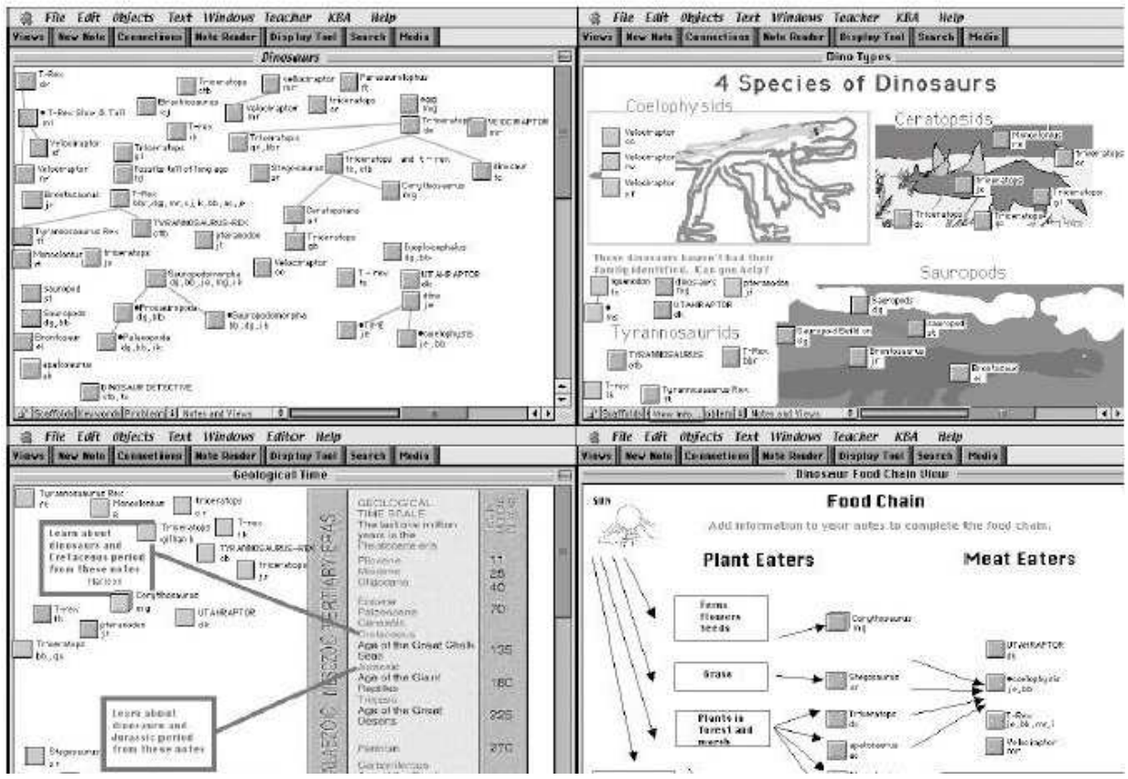

Fig.1. User Interfaces of Knowledge Forum

In order to support knowledge building, Marlene Scardamalia and Cal Bereiter along with their team designed Knowledge Forum previously called CSILE (Computer Supported International Learning Environment) before 1996. CSILE was aimed to provide external support for objective-oriented learning and knowledge construction via information technologies helping communities transfer from the task-oriented type to the knowledge construction type. The core concepts of Knowledge Forum are composed of objective-oriented learning, expertise process and knowledge construction communities. As an

environment for activities, knowledge forum converts knowledge into an objective-based activity through supporting presentation, expression and transformation of information and opinions with learners writing "note"s to express themselves.

Learners can offer an "opinion" to integrate all existing notes to form a more complete and more systematic opinion as the upper level. Knowledge forum provides six types of tools to support collaborative knowledge building. The first type is "based on" which can allow learners to build their own opinions on the basis of others' opinions. The second is "quote" which can allow learners to quote an existing note in the system knowledge base. The third is "annotate" which helps learners comment on others' opinions. The fourth is "collaborative creating" with which learners can modify text, images of others if authorized to edit records by writers. The fifth is "published status". When the writers think their opinions worth publishing they can set the "published status"up of the opinions. The last tool "refine" is the most powerful tool allowing users to refine the theories or opinions through collaboration and integration by users to form new theories or opinions. After refinement, the former theories or opinions will disappear from the knowledge base.

Knowledge Forum is tried and promoted over several districts of the world currently in an effort to make a clear objective-based learning process to guide students to bear more responsibilities of helping others learn and to support organizing a knowledge building community with technology. As a new theory of learning, knowledge building looking forward to the prospect to some extent complies with requirements for learning and instruction from time.

3. Knowledge engineering and knowledge building in e-learning

3.1 General view of knowledge engineering

The phrase Knowledge Engineering originates from artificial intelligence. On the fifth International Joint Conference on Artificial Intelligence the professor Feigenbaum at the computer department of Standford University introduced the name "knowledge engineering", which is the landmark for knowledge operability.

As for the history of knowledge engineering, it is created while "expert system" building was under investigation. In truth, the focal point of knowledge engineering is knowledge. The research directions of Knowledge engineering encompass knowledge acquisition, knowledge representation, knowledge reasoning and so on. Knowledge engineering is aimed to dig and extract human knowledge and to represent this knowledge with certain form which can be subject to computer processing so that computers can possess certain intelligence. The knowledge engineering on the basis mentioned above is a discipline that involves human intelligence and human knowledge and how to use computers to simulate human intelligence to develop human knowledge.

3.2 The relationship between knowledge engineering and knowledge building

Considering the evolution of theories of knowledge, modern constructivism emphasizes sociality, context, constructively, complexity and implicity while knowledge engineering as key means of knowledge building in on-line learning is influenced by artificial intelligence, database technology, mathematical logic, cognitive science, psychology and so on, moving

towards intelligentization and openness. The relationship between knowledge engineering and knowledge building is illustrated in terms of three factors of knowledge engineering: knowledge acquisition, knowledge representation and knowledge application.

3.2.1 Knowledge acquisition

Constructivists attach great importance to the origin and acquisition of knowledge, which is opposed to rationalists' theories. The Swiss psychologist Piage points out that knowledge is gradually built during the process of interaction between subjects and environment by means of assimilation and accommodation so that the cognitive structure can be developed. Vy-gotsky maintains that knowledge is acquired through interaction between individuals and society and transformation from external, expanding, collective activities to internal, concise, individual form in a certain socio-cultural background. Scardamalia and Bereiter hold that knowledge is not the truth stored in individuals' brain but collective knowledge created in a collective effort through group discussion. Above all, constructivism regards sociability and contextuality as central elements in knowledge acquisition, which is well displayed in knowledge acquisition of knowledge engineering. The acquisition of knowledge is expanding from the unidirectional communicator-to-communicator pattern of transmission to the multidirectional and interactional human-to-computer pattern in the online environment. Everyone is in the link of the knowledge web and can act as an expert to use their power of knowledge, accept knowledge, consume knowledge, retail knowledge and create knowledge, which completely demonstrates diversity and universality of knowledge acquisition in the eyes of post-modern theories of knowledge.

In the knowledge engineering domain, means of acquiring explicit knowledge include Distributed Searching and date mining. Distributed Searching means to create distributed index server on the standards of districts, topics and so on. The index servers can exchange medium information and a query can be redirected. If a searching server fails to satisfy a query, it can send the requirements of the query to a searching server which contains related information. The Distributed searching engine is a searching strategy which can be used in knowledge query and retrieval in relation database, Special-purpose document internet searching site, web and so on, which can help acquire explicit knowledge in the related domains broadly.

Data mining refers to a high-level process of extracting reliable, new, effective information from a huge amount of data in an understandable pattern. Data mining is not just simple searching, inquiring and transferring towards special database but also conducting statistics, analyses, synthesizing and reasoning in micro, middle and macro ways to receive solutions to actual problems, to discover relations between events or even to predict future activities in use of existing data. It discovers and acquires knowledge through data extraction, preprocessing, transferring, pattern extraction, knowledge evaluation and process optimization by means of applying statistical methods including discriminant analysis , cluster analysis and exploratory analysis.

The way of acquiring tacit knowledge is non-automatic knowledge acquisition (manual acquisition), semi-automatic knowledge acquisition and automatic knowledge acquisition. Non-automatic knowledge acquisition refers to complete manual work while semi-automatic knowledge acquisition means that the work is finished through joint efforts of

knowledge engineers and knowledge acquisition institutions in expert systems. Knowledge engineers are responsible for extracting knowledge and representing the knowledge in proper patterns while knowledge acquisition institutions in the expert system are responsible for transferring knowledge into internal forms which can be stored in computers and putting them into knowledge base. Automatic knowledge acquisition means that the system can automatically modify and perfect knowledge base with users' responses to results and can automatically accumulate and form various kinds of useful knowledge during solving process.

3.2.2 Knowledge representation

Knowledge representation can be viewed as a set of rules on objects used to represent human knowledge as data structures. The process of representing knowledge is to encode knowledge into certain data structures. Knowledge representation breaks down into two types including declarative knowledge representation and procedural knowledge representation. Declarative knowledge representation refers to processing separately knowledge representation and knowledge application. When representing knowledge, how to apply the knowledge is hardly involved, which is a static way of describing. Procedural knowledge representation is to combine knowledge representation and knowledge application. The knowledge is in the programme, which is an active descriptive way. The ways of knowledge representation commonly seen are:

The first-order predicate logic representation: this is an important way of knowledge representation based on logic. It has been the most accurate formal language to represent human mind and reasoning until now. The way of representation is considerably close to human natural language and the representation can be accurately reasoned by computers.

The Production Representation which is also called The Production Rule Representation enjoys the same computing ability of Turing machines. Recently, production representation has become one of the mostly used forms of knowledge representations in the artificial intelligence applications. The production representation normally is used to represent knowledge of causal link with the basic form that P→Q or IF P THEN Q where p is the premise or condition of the production while Q is a set of conclusions or movements. P is used to point out whether the production is a usable condition while Q is to display what conclusion or operation should be made when the premise p is satisfied. P and Q can be a or a set of mathematical expressions or natural languages.

Frame representation: it is a structuralized knowledge representation based on frame theory suitable for representing various types of knowledge. The basic views of framing theory: human brains have stored abundant typical scenarios. When facing new scenarios, people can select a basic knowledge structure named a frame from their memory. The specific content of a frame changes from new scenarios, forming knowledge on new scenarios and store that in human mind.

Semantic networks representation: a Semantic network is a structuralized graphic formed by nodes and arcs or links which represent knowledge. A semantic network representation consists of four related parts: (1) The lexical part involving each nod or arc determines what symbols are allowed to appear in the representation vocabulary list. (2)The structure part appointing the nod pairs connecting arcs describes the limits on the order of symbols. (3)The

process part states the access process which can be used to build and modify the description and answer related questions. (4)The semantic part ascertains the ways of describing associated meaning namely ascertains the sequence of related nods and the possession and corresponding arcs. The semantic networks have already become a mostly applicable form of knowledge representation especially in the natural language processing.

Object-oriented representation: in recent years, when designating and constructing the intelligent systems, people have started to utilize object-oriented thoughts, means and development technologies in knowledge representation, organization and management of a knowledge base, expert systems design, which accomplishes rapid growth.

Therefore, knowledge representation can organize the content into a number of reusable smaller parts and build meaningful, direct links among them so that users can swiftly locate all the relative knowledge, which makes it convenient for users to build knowledge. It can be discovered that knowledge representation is spreading information origins on the basis of a great amount of denotation and connotation of explicit knowledge, reorganizing and processing information itself and excavating implicit and deeper layer information and knowledge from relational data base. The process mentioned is consistent with the evolution of human theories of knowledge. Human's attention transfers from objective explicit knowledge gradually into subjective, individual, contextual tacit knowledge, which accompanies knowledge representation changing from standardization, hierarchicality into conceptualization, cognitive maps, problem solving.

3.2.3 Knowledge application and management

Objectivistic theories of knowledge suggest that objects exist objectively and knowledge is the presentation of objects. Scientific definitions are corresponding to various objects. Scientific propositions, theorems are the only correct and true interpretation of objects which experience scientific examinations. The application and management in the knowledge engineering is not the process or method of studying specific knowledge applications but possible ways or patterns that could be used in various concrete knowledge applications including reasoning, searching, knowledge management and maintenance, matching and identifying. Reasoning refers to studies concerning various ways or patterns of reasoning including various logical relations between premises and conclusions, the transfer rule of truth degree or the confidence level. Search refers to studies related to all kinds of searching means and methods. It is to search or explore a certain object which can satisfy given conditions or requirements in the myriad object (including knowledge itself) space. Knowledge management and maintenance include all kinds of operations (retrieval, adding, modifying or deleting) of the knowledge base to assure the consistency and completeness of knowledge in the knowledge base. Matching and identifying refer to various principles and methods of finding one datum or more data or object matching the given template and identify various objects in the environment consisting of solely incomplete information or knowledge.

Above all, knowledge engineering aimed at realizing the order and organization of knowledge pays more attention to practical engineering operations of knowledge, through proper exchange of matter, energy and information between systems and external world, negative entropy increase, cooperation and competition of nonlinear systems to realize self-

organizing and hetero-organizing activities. During the process, information, knowledge and intelligence appear alternatively and interconvert into each other. The position of Information, knowledge and intelligence in the entire information process and the relationship among them fit the process of information creating knowledge and knowledge activates intelligence in the activities of human building the perception of the world and improving the world. However, the current studies of knowledge engineering has hardly involved and solved the theoretical problems of knowledge itself nor have they revealed the essential relations among "information-knowledge-intelligence". Revealing the knowledge building process will enhance exploration of the relations among the three factors and realize the shift from knowledge to intelligence in actual practices.

4. Knowledge services and knowledge building in e-learning

4.1 Overview of knowledge services

As for definitions of knowledge service, three major views are listed below: solutions to users' problems are emphasized. This type of concepts focus on providing users with knowledge products or service during problem solving process through the serving staff's own knowledge and abilities. (2)this type of view displays the concept of knowledge management employing the transformation between explicit knowledge and implicit knowledge, which emphasizes the value of exploiting tacit knowledge (3)distinguish knowledge service in a broad view from knowledge service in a narrowed view, which emphasizes layers of knowledge service.

Knowledge service is a type of comprehensive knowledge-intensive and procedural service. It realizes the combination of knowledge service experts, related research group, various distributed information resources and computer technologies along with the combination of various theories of information knowledge, human experience and knowledge. It is knowledge content oriented. The value and core competitive strength of knowledge service mainly lie in the amount of knowledge and the density of knowledge content. It can provide users with the product and service at different layers because of different amount of knowledge to different types of knowledge requirements. In addition, knowledge service itself is an iterative process of knowledge acquisition, knowledge absorption, knowledge innovation and knowledge application, adjusting and optimizing knowledge service products and solution plans in the entire science research process.

Studies on the knowledge service aboard fall into theoretical and practical aspects. In the theoretical studies, the experts on the Canadian knowledge service programs proposed knowledge service system models and theory frame based on knowledge service process (Simard A, 2007). N. F. Abernethy explored frame-based knowledge service system on database management system (DBMS) (Abernethy, N. F. et al, 1999). The E-service project funded by Danish Research Agency systematically studied the development of knowledge service theories and created the roles and related products through case studies of service institutions and clients. UNDP (United National Development Program) identified the connotation, task and range of knowledge services.

A majority of studies focusing on the semantic Web technologies as to knowledge service applications for example York Sure hold that semantic Web technologies play a core role in the knowledge base of digital libraries and object semantic description (Sure Y. & Studer R,

2007). A.Sheth published research results concerning ontology-driven information retrieval, analysis and integration of application systems (Sheth A & Ramakrishnan C, 2003). Based on the studies, some scholars build ontological knowledge service frames pointing out that ontological representation technologies can transfer complex information resources into information that could be understood and processed easily by machines. Additionally, a number of institutions have made creative attempts on knowledge service applications for instance, LMC provides computer technologies based on knowledge Byte to produce customized multimedia knowledge transmission experience, which makes knowledge shared in a building or over the world.

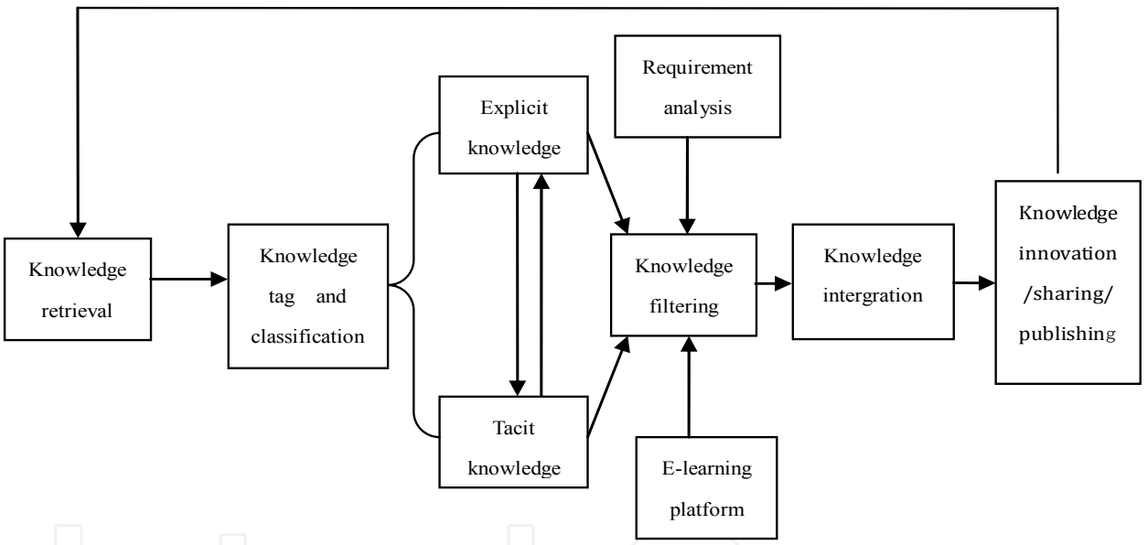

Fig. 2. the knowledge services model based on the on-line knowledge building

4.2 The knowledge services model based on the on-line knowledge building

After the overview of knowledge building, knowledge engineering and knowledge services combined with on-line learning features, the knowledge services model for on-line knowledge building are developed as shown below:

4.2.1 Knowledge retrieval

The knowledge retrieval consists of explicit knowledge and tacit knowledge. Traditional knowledge retrieval can access to abundant data and information with low retrieval rate and small amount of knowledge. In contrast, knowledge retrieval in the knowledge services draws on the advanced theories and technologies in various disciplines including information technology, artificial intelligence, cognitive science and linguistics. It serves as a advanced information retrieval means to fully represent and optimize users' requirements extracting all media type knowledge sources(text, image, video, sound etc) and selecting accurately the result users required. This type of knowledge retrieval emphasizes reveal of knowledge unit and knowledge connection as a match of knowledge and semantics based on Web page information. It can be regarded as an advanced information retrieval way to realize intelligent query based on understanding of the information semantic content on the premise that a nonlinear knowledge organization of the knowledge retrieval is conducted. The realization of knowledge retrieval can hardly succeed without the support of artificial intelligence and knowledge engineering.

Normally, the knowledge building systems can provide knowledge retrieval function in the actual practices. The major objective is to solve the problem of retrieval of structured data and non-structured data. For instance, apart from queries of some characteristics of elites, queries of the content of the resumes are of more importance. In the mean time, it can provide semi-structured content retrieval and intelligent knowledge retrieval based on XML as well, for example, if the word "computer" is be searched, all the information contains "computer" will be retrieved, which is the primary stage of intelligent retrieval. Intelligent retrieval should pay more attention to the text extraction function. On the knowledge interface provided, a guidance tool for users is called for in order to increase the utilization efficiency and provide convenience for knowledge organization and sharing of internal and external tacit knowledge of enterprises.

4.2.2 Knowledge tag and classification

After searching, knowledge can be classified and tagged. Classification mainly means to divide knowledge into explicit knowledge and tacit knowledge. Tacit knowledge refers to experience judgment and behavior tendency of a subject based on their instinct and perception of objective events in their working and living practices. The formation of tacit knowledge is a process of learning accumulation and innovation during which different subjects affect each other. Tacit knowledge is hard to be formalized. It can hardly articulated existing deeply in personal experience, decisions, associations, innovation and sub-consciousness. In addition, hard to be standardized and transmitted to others, implicit knowledge demonstrates as experience, skills, abilities or know-how. Fixed and visual, different from the former type of knowledge, explicit knowledge can be transmitted in standard and systematic languages. Any kind of knowledge that can be defined, written or put in computers can become explicit knowledge. According to related studies, explicit knowledge appears in a small amount in a majority number of organizations. The majority of knowledge exists in human as tacit knowledge.

The chief use of tagging is to offer every categories a proper name which can comply with people's habits and include all items of the type while distinguish from items of other types.

The way of tagging is to pick up a series of key information which can cover the content property and be used as the access of user's searching from the documents. Using the information to tag the document can help gain access to the knowledge of the document by putting in keywords. Methods and technologies of ontology can be used to create knowledge structures and conduct tagging for the reason that ontology provides standard ways of specifically describing a certain field and store the data collected to meta-data base according to regulated structure.

4.2.3 The platform for knowledge exchange –tacit knowledge transferring into explicit knowledge

After explicit knowledge and tacit knowledge being indentified, a platform for knowledge exchange is provided to promote transferring from tacit knowledge into explicit knowledge. Knowledge map is regarded as a favorable tool for the transformation. It can assist users to find knowledge points in a short time through accurate expression and classification of concepts and knowledge relations and can return to related knowledge sources so that organizations can assemble intelligent sources of the entire organization in the fast speed with easiest operations when crucial decisions are expected to be made. In the mean time, the knowledge community as a platform for knowledge exchange can be introduced so that staff of the organizations or cooperative partners can log in the knowledge portal and communicate and leave a message to realize transmission of tacit knowledge.

4.2.4 Knowledge filtering

After fully investigating users' requirements, knowledge acquired should be filtered through the on-line instructional platform. Various forms of knowledge should be assembled. First, compatibility of knowledge should be taken into consideration. Compatibility is the basis and rules that decide whether knowledge in various fields can build up collective relations and form collective system judgments and choices. Second, the organizational absorption of the target knowledge should be analyzed. Knowledge integration is built on the full understanding and absorption of knowledge. Third, the quality of knowledge source should be assessed since only knowledge of high quality can realize excellent service effect. Last, integration of knowledge application and user requirements should be analyzed considering that the ultimate goal of knowledge services is to satisfy clients' requirements and create value, which makes it a vital link.

4.2.5 Knowledge integration

Knowledge integration refers to a series of orderly and systematic activities including organizing, processing, revealing, controlling on knowledge objects employing certain organizing tools, methods and standards based on the inner logical relations of knowledge. The aim of the knowledge integration is not simply to order knowledge storage and provide knowledge but to realize knowledge representation of knowledge mining by means of integration analysis, induction, reasoning and so on. As a high form of knowledge organization, it embodies the characteristics of automation, integration, and intelligentization. The knowledge organization methods adopted consist of knowledge reorganization, knowledge clustering, knowledge storage, knowledge editing, knowledge

layout, knowledge monitoring and so on. The knowledge organization technologies are composed of super-text technologies, expert systems, data warehouse and knowledge mining.

4.2.6 Knowledge innovation, sharing, publishing

Eventually knowledge integration results in knowledge innovation, sharing and publishing. On one aspect, the knowledge is shared by members of organizations in the form of explicit knowledge. On the other aspect, the knowledge is digested by members after members learning of the explicit knowledge, which constructs major sources for knowledge searching for the reason that the knowledge is fixed into individuals and the organization and gradually becomes their implicit knowledge. In the end, each member can contribute to collective knowledge creating new knowledge in the formed knowledge building communities. In addition, knowledge sharing in the organization brings out knowledge innovation and growth.

5. Conclusion and future research

The web environment gives rise to criticisms of the objectivity, universality and neutrality of knowledge in the first place. New theory of knowledge emphasizes culture, contextuality, value and diversity of knowledge along with interaction between individuals and environment and interaction between individuals and the learning community. Moreover, in support of knowledge building of learners, knowledge engineering is moving towards ubiquitous knowledge acquisition, clear representation, orderly data organization, ontological content storage. Adapting to the direction mentioned above, the services for knowledge are hardly confined to simple knowledge management, which means that a series of changes should be made in certain elements ranging from searching, tagging and classification, communication, filtering, integration of knowledge to innovation, sharing, publishing of knowledge in order to form active, smart, personalized knowledge services. In the end, cloud computing and cloud services enrich the online learning environment where we can create personalized web learning environment easily and smoothly. In the mean time, cloud computing and cloud services play a crucial role in timeliness of knowledge building, integration of instructional resources and promotion of communication and collaboration. The knowledge building methods of human brains, the support for knowledge building by semantic web and the relationship between knowledge building of robots and human beings will be explored as to the future research goals concerning the web-based knowledge building.

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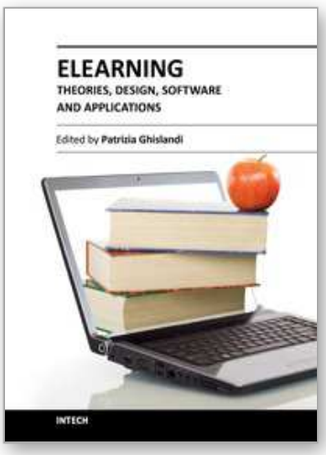

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The term was coined when electronics, with the personal computer, was very popular and internet was still at its dawn. It is a very successful term, by now firmly in schools, universities, and SMEs education and training. Just to give an example 3.5 millions of students were engaged in some online courses in higher education institutions in 2006 in the USA1.eLearning today refers to the use of the network technologies to design, deliver, select, manage and broaden learning and the possibilities made available by internet to offer to the users synchronous and asynchronous learning, so that they can access the courses content anytime and wherever there is an internet connection.

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