Theoretical-based on Learning Goal in E-learning System

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Abstract

E-learning system plays an important role as one of new trends of educational system. It is, however, lack of theory to support each learner's goal. There are a lot of theories that simulate learning environments and design each learner's role in order to achieve his/her own personnel goal. In this paper, we proposed learning goal and shows some examples on applying the goal in e-learning system.

1. Introduction

Due to the spread of Internet usage, e-learning become a major role in computer-based education. It allows participants to learn at their own pace and access materials through the Internet when it is convenient for them. In general, each participants in e-learning system is expected to achieve his/her own personnel goal, while organizations is aimed to get the success from the individual achievement. To construct an effective e-learning system, it is necessary to answer " how to construct the learning system that achieve the learning goal for both personnel perspectives and organization perspectives".

There are a lot of theories that explain the situation to reach an objective for whole group depending on participants' individual goal. In this paper, we define the personnel goal and social goal, Personnel goals is classified into two types; I-goal is the learning goal that represents what a learner acquires, and Y<=I goal is the learning goal that represents the means to attain I-goal. Social goal is defined as W-goal. It is a whole group goal that represents the situation setting up to attain Y<=I goals. Applying these goals to e-learning system will help us achieve both personnel perspectives and social perspectives.

In this paper, we illustrate the design on e-learning system, mixing between individual learning and collaborative learning approach based on the learning goal that we proposed. After that we give some case studies on e-learning through learning goal. The LearningNuke e-learning system which is constructed by NECTEC and EGAT is shown as example.

2. Learning Goal for e-learning system

There are many theories that explain on environments for grouping learner by concentrating learner's role, activity and goal. For instance, Sociocultural Theory[31], Zone of proximal development[31], Constructivism [3,10], Self-regulated learning[12,26], Situated cognition[19], Cognitive apprenticeship[20], Cognitive flexibility theory[27,28], Observational learning[1], Distributed cognition[25], and so on. These theories are

derived from a wide research area including pedagogy, sociology and psychology. We can expect different effects through learning process based on these theories. There are many kinds of learning goals dependent on learning situations.

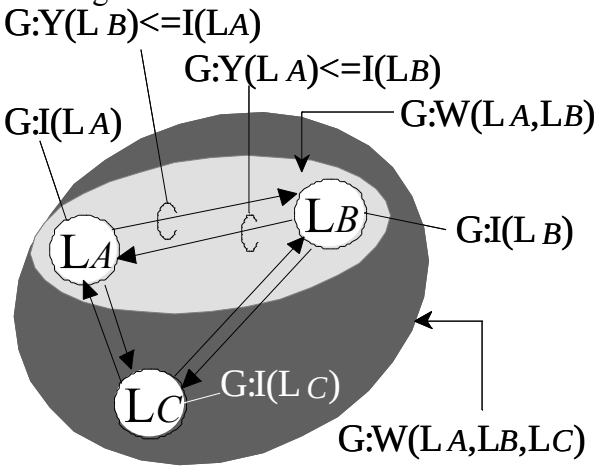

Figure 1. A structure of learning goal

In this paper, we classify learning goals achieved through learning process into the three kinds: I-goal, Y<=I-goal, and W-goal. I-goal, which is described as G:I, represents what a learner acquires through the learning process. Y<=I-goal, which is described as G:Y<=I, represents the means to attain I-goals. Both I-goals and Y<=I-goals are personal goals. W-goal expresses the situation setting up to attain Y<=I-goals and we describe the goal as G:W. W-goals are social goal as a whole group.

Figure 1 represents the structure of learning goals as an example where three learners: L_A, L_B and L_C exist. Learner L_A has an I-goal to attain through this learning process and this goal is described in the Figure 1 as G: I(L_A). Both L_B and L_C have I-goals, and they are represented by G: I(L_B) and G: I(L_C) respectively. G: Y(L_B)<=I(L_A) is a Y<=I-goal between L_A and L_B observed from L_A's viewpoint: the reason why L_A interacts with L_B. Concerning this interaction between L_A and L_B , there is a Y<=I-goal observed from L_B's viewpoint, too: the reason why L_B interacts with L_A. This Y<=I-goal is represented as G: Y(L_A)<=I(L_B). Both G: I (L_A) and G: Y(L_B)<=I(L_A) are personal goals of L_A. G: W(L_A,L_B) is a W-goal of the learning group (L_A and L_B). G: W(L_A,L_B,L_C) is a W-goal of the learning group (L_A, L_B and L_C).

Table 1 shows the I-goals. The learner is expected to achieve these I-goals through interaction with another learner. Table 2 shows the Y<=I-goals. For example, to achieve an I-goal "acquisition of new knowledge", some learners could take the Y<=I-goal "learning by being taught". Some learners could take the Y<=I-goal "learning by participating" in a more advanced group as an

Table 1. I-goals

I-goal	Definition	Source
Acquisition of Content-Specific Knowledge (Accretion Tuning Restructuring)	To add new knowledge concerning the target domain to existing schemata, to understand it, and then to (re) construct knowledge structure	[1],[3],[4],[6], [7], [11], [14], [15], [22],[24]
Development of Cognitive Skill (Cognitive Stage Associative Stage Autonomous Stage)	To get knowledge concerning cognitive skills such as diagnosing and monitoring, to practice them, and then to refine them	[2], [3], [13], [24]
Development of Metacognitive Skill (Cognitive Stage Associative Stage Autonomous Stage)	To get knowledge concerning metacognitive skills for observing self-thinking process, diagnosing it and regulating or controlling of self-activity, to practice them, and then to refine them	[8], [12], [24], [26]
Development of Skill for Self-expression (Cognitive Stage Associative Stage Autonomous Stage)	To get knowledge concerning the skills for externalizing self-thinking process and presenting the learner's self-perspectives, to practice them, and then to refine them.	[4], [27]

Table 2. Y<=I goals

Y<=I goal	Definition	Source
Learning by Observation	Learning indirectly by observing other learner's learning processes	[1]
Learning by Self-Expression	Learning by externalizing self-thinking process, such as self-explanation and presentation	[4], [27]
Learning by Teaching	Learning by teaching something he/she already knows to other learners	[4], [15]
Learning by being Taught	Learning directly by being taught by other learners	[15]
Learning by Apprenticeship	Learning by observing other learners' behavior and then imitating it	[5]
Learning by Doing	Learning by applying knowledge or skills to a specific problem	[19], [20]
Learning by Diagnosing	Learning by diagnosing other learners' processes	[7], [16]
Learning by Guiding	Learning by demonstrating knowledge or skill to other learners and guide the learners	[5]
Learning by Reflecting	Learning by rethinking and observing the learner's self thinking process	[27], [28]
Learning by Discussion	Learning by discussion with other learners	[9], [24]. [25]

Table 3. W-goal

W-goal		Definition	Source
Single ton	Peer Tutoring (PT)	Setting up the situation where a learner teaches something to another learner	[6], [11]
	Anchored Instruction (AI)	Setting up the situation where a learner diagnoses another learner's problem and then solve it (Problem-based Learning)	[7]
	Cognitive Apprenticeship (CA)	Setting up the situation to learn knowledge or skill as an apprentice	[5]
	Sharing (meta-)cognitive skill between learners (SC)	Setting up the situation to share cognitive or meta-cognitive function between learners based on Sociocultural Theory	[30], [31]
	Sharing Multiple Perspectives (CE)	Setting up the situation to evoke a learner's reflective thinking based on Cognitive Flexibility Theory	[14], [27], [28]
	Setting up Distributed Cognition (DC)	Setting up the situation where full participants, whom knowledge bases are different each other, discuss problems	[24], [25]
	Setting up Cognitive Constructivism (CC)	Setting up the situation where full participants discuss problems	[23]
Com posite	Setting up Community for Legimitate Peripheral Participation (CPP)	Setting up the community of practice for peripheral participant	[1]
	Setting up Observational Learning environment (OL)	Setting up the situation to share other learner's learning processes	[19], [20]

Table 4. Learner's Role and Activity

Activity	Definition	Role in **W-goal**	Source
Observing	Observe other learner's processes	Observer **OL**	[1]
Tutoring	Explain other learners about his/her knowledge	Peer Tutor **PT**	[6], [11]
Passive Learning	Receive other learners about new knowledge	Peer Tutee **PT**	[11]
Presenting	Explain other learner's processes on problem solving, cognitive, and self-thinking	Problem Holder **AI** Panelist **CE** Client **SC**	[7], [27], [28], [30], [31]
Advising	Advise other learner's processes on problem solving, cognitive, and self-thinking	Anchored Instructor **AI** Diagnoser **SC**	[7], [30], [31]
Reviewing	Compare among learner's processes	Audience **CE**	[27], [28]
Imitating	Observe and imitate behavior of other learners that have much more knowledge and skill	Apprentice **CA**	[5]
Guiding	Guide and explain the processes for applying knowledge or skill to other learners	Master **CA**	[5]
Problem Solving	Solve problem with other learners	Peripheral Participant **LPP** Full Participant **CC** **CD**	[19], [20], [22], [25]

apprentice. Table 3 shows the W-goals. Each W-goal can be expressed by a set of I-goals and Y<=I-goals. Table 4 shows the activity and role for each participants in W-goal.

The information in details on each goal and functionality can be found in [18,29]. With these goals, the instructors, who initiate a learning process for learners, can identify learner's personnel goal, both I-goals and Y<=I goals and can design various kinds of environments for grouping appropriate learners under W-goal. It will helps instructors can predicate educational benefits gained through the learning goal.

3. LearningNuke

LearningNuke is an open source e-learning system which is provided by the collaboration between EGAT(Electricity Generating Authority of Thailand)and NECTEC(National Electronics and Computer Technology Center). The main purpose is to support the ITEd project [17], a project on the Capacity Building on the Development of Information Technology for Education, under the support by Japanese government and JICA.

3.1 LearningNuke Architecture

LearningNuke composed of three main components; Learning Management System (LMS), Learning Content Management System (LCMS) and Learning-supported Tools as shown in figure 2. Features on each component can be explains as follows

3.1.1Learning Management System

Learning Management System is a component that mainly administrate learners in the system. It is composed of the five modules; Student Management Module, Course Management Module, Student Skill

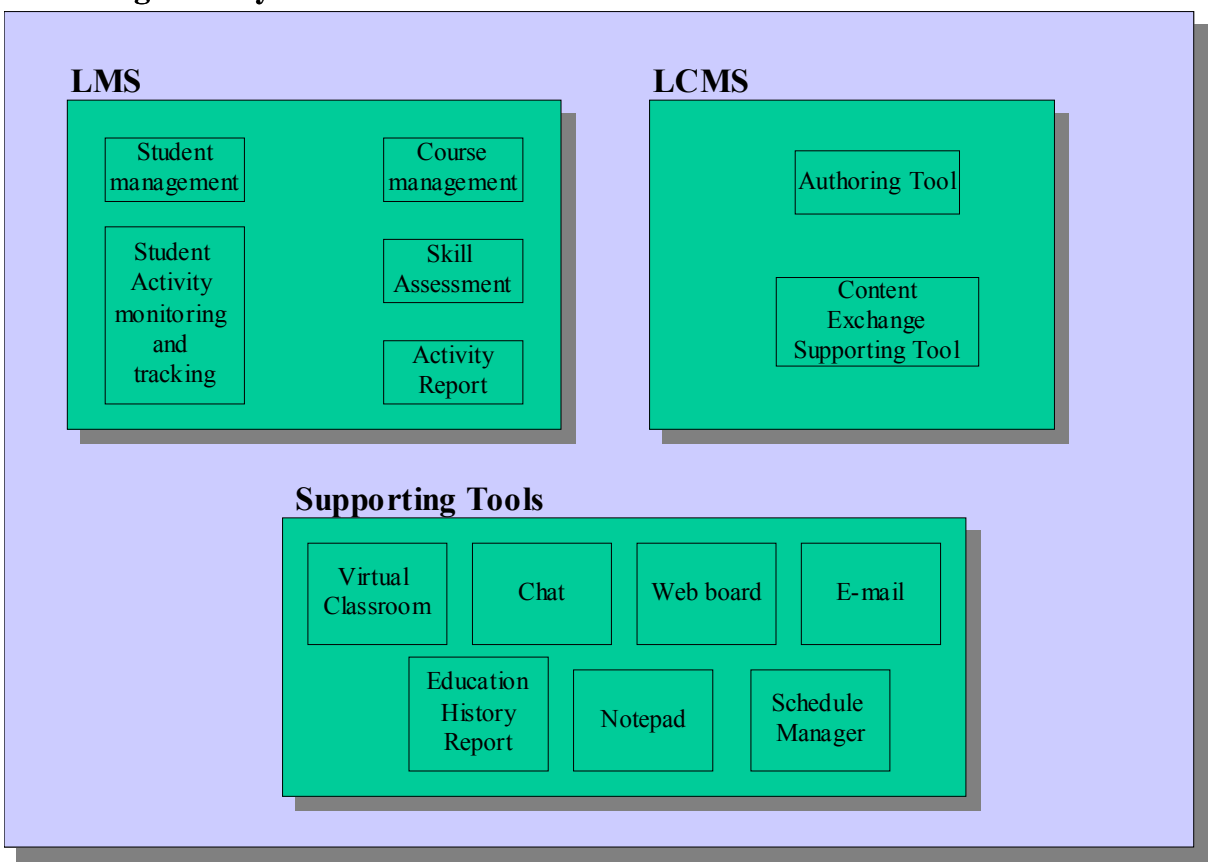

Figure 2. An architecture on LearningNuke system

Assessment Module, Student Activity monitoring and tracking Module and Activity Reporting Module.

3.1.2Learning Content Management System

Learning Content Management System is a component that mainly helps instructor to apply content to the system. It is composed of the two modules; Authoring Tools Module and Content Exchange Supporting Tools Module.

3.1.3 Learning-supported Tools

Learning-supported Tools is a component that mainly support learners to assist two-ways communication. It is composed of the seven modules; Virtual Classroom, Chat Room, Web board, E-mail System, Education History Report, Notepad and Schedule Manager.

LearningNuke is available as a trial version at http://ited.nectec.or.th. Figure 3. shows examples on Student Page, Course management Page, Virtual Classroom, and Member's role setting Page. The system supports SCORM standard and is possible to view a course content in Web-based, MS office and pdf format. It can show in text, speech, graphic and animation.

3.2 Member Types in LearningNuke

Member in LearningNuke can be classified into four types. User is a member who has the lowest priority in the system. The member who joins the system as a student is usually assigned in this type. Helper is a member who helps instructor to motivate and give advises to student. Helper can view the students' result and give a score to students. Instructor is a member who joins a system as a teacher, instructor can construct the course outline,

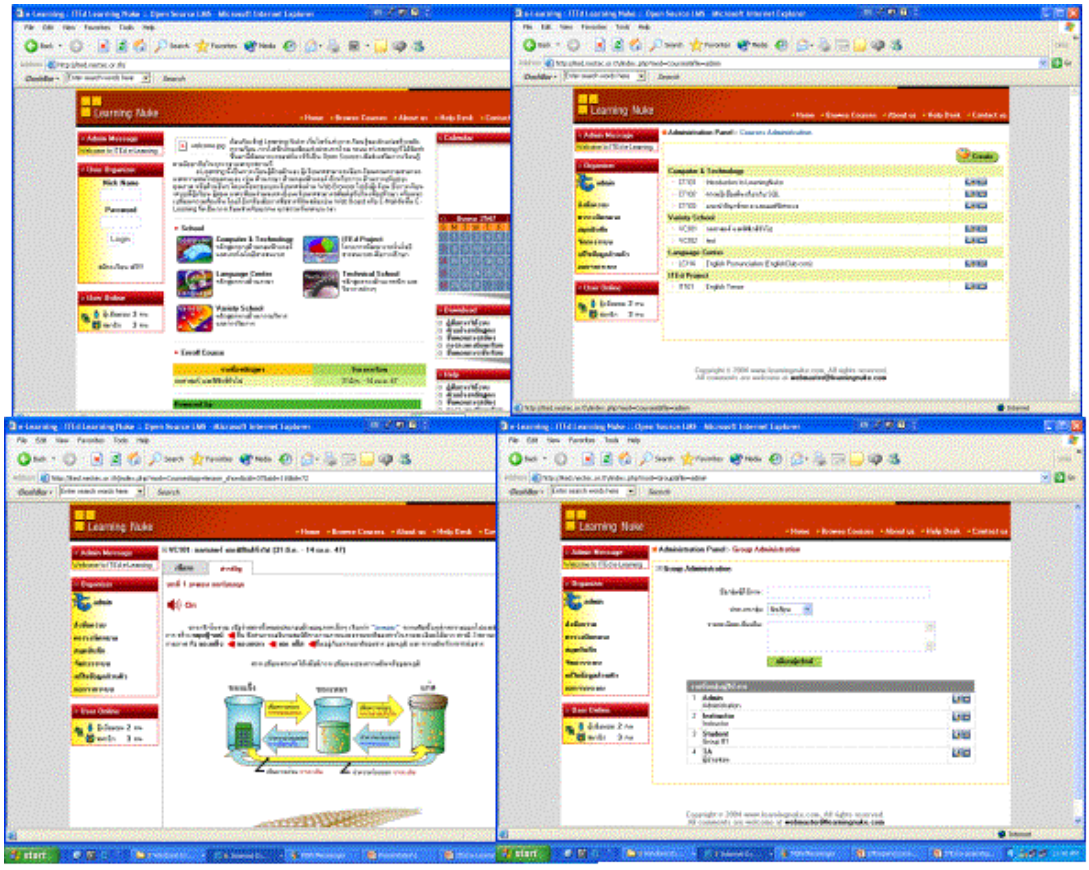

Figure 3. Examples on pages in LearningNuke

manage a flow of course content and evaluate students' result. Administrator is a member who manage modules in the system, assign role of members in the system and essential component for learning environments. This member type has a highest priority in the system.

4. Apply learning goal to LearningNuke

LearningNuke provides components to help constructing the course content, anywhere anytime accessible tools for students and collaborative tools for communication among all members in the system. Furthermore, LearningNuke provides four member types. With these fulfill environments, it is possible to apply various kinds of W-goals to set the appropriate learning environments.

4.1 Apply LearningNuke as individual perspectives

Normally, we apply e-learning system as a system that provide a course content from instructors to students. Instructors can design their courses, guideline, teaching method through the content in the system. Students can access to the system and learn the contents by themselves. Traditional e-learning system focuses on how to manage a good content for students. It is "Peer Tutoring" W-goal type. An I-goal, Acquisition as a specific-knowledge, is the main objective. In case the topics are focused on the knowledge for skill acquisition, the Development of cognitive skill, metacognitive skill and self-expression skill on cognitive stage may partially be settled as I-goals.

4.2 Apply LearningNuke as social perspectives

It is possible to apply member types to construct other learning environments. If we assume that A teacher act as an administrator, he/she can define student's role in e-learning system and monitor the results from the system. It is possible to construct W-goal as shown in Table3.

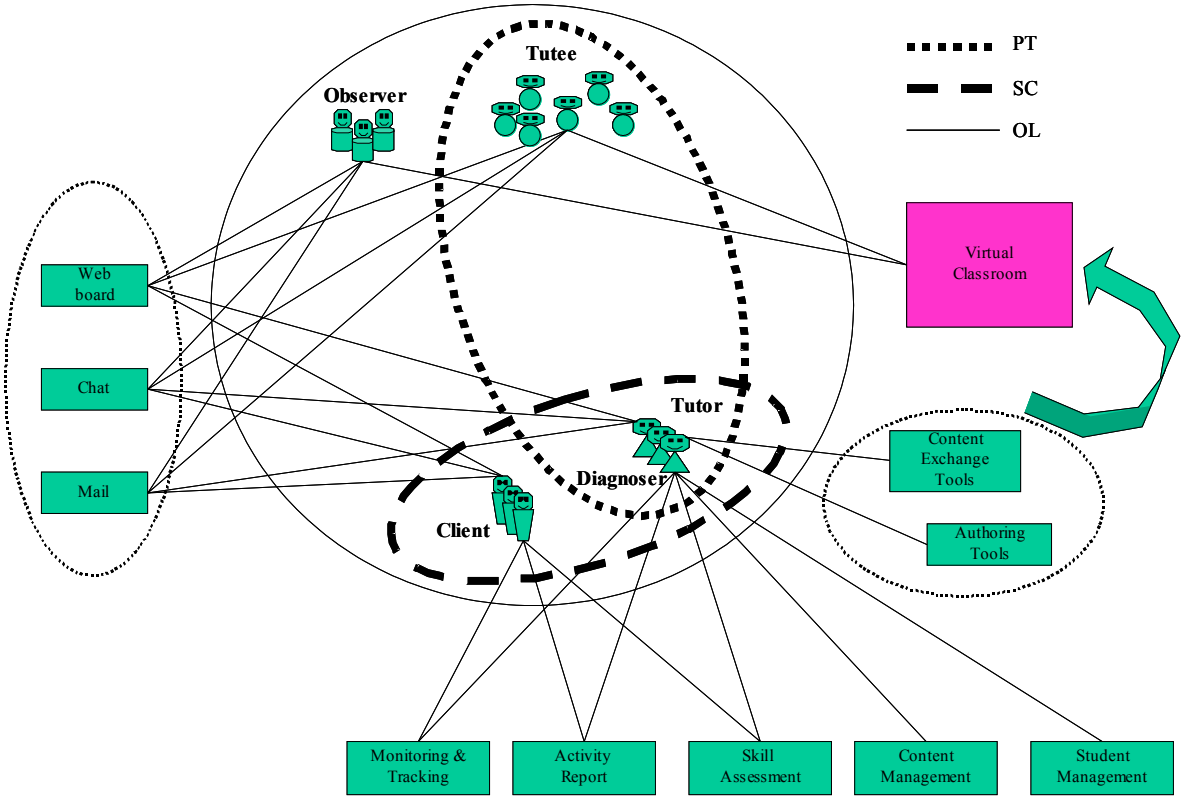

Figure 4. An Example on Apply LearningNuke based on W-goal

Figure 4. shows an example on applying LearningNuke based on W-goal. There are three W-goals are combined in the figure; Peer Tutoring, Sharing (meta-)Cognitive skill between learners and Observational Learning. Peer tutoring is taken place at virtual classroom. A Tutor (Instructor in the system) will construct a course content by using Authoring tools and/or use Content exchange tools to transfer contents from others LMS systems that are constructed under the SCORM standard. Tutor will attain the teaching skill, self-expression skill and the acquisition of knowledge in tuning and restructuring stage. Tutees (User type in the system) will read and understand the content. They will get the acquisition on knowledge. Sharing (meta-)Cognitive skill between learners is a situation that a client (Helper type in the system) has an interaction with tutees. In this activities, he will attain diagnosing skill from giving a score to tutees. Diagnoser, who is the same person as Tutor(Instructor type in the system), will diagnose clients' activity and advise him/her. Diagnoser will attain his autonomous stage in skill acquisition. Observational Learning environment is taken place at others learning tools, such as web board, chat. Observer (Users who do not join this course in the system) can observe the interaction between tutor and tutees, between tutees and client, or among tutees. Observer will attain the acquisition of knowledge in accretion stage from observing activities. In some cases, observe can also understand the content from virtual classroom.

5. Conclusion and Future Work

We explained the three kinds of learning goals, which is derived from vairous leanring theories and apply them to our e-learning sytem, LearningNuke, which is an open source e-learning system. It is possible to construct a more complex learning environments in order to achieve not only knowledge acquisition aspects, but also skill acquisition aspects. In order to accomplished this, one important topics is how to construct the appropriate content, how to design a flow to induce learners to get both I-goal and Y<=I goal. We are considering the methods to construct a good authoring tools to reach our goal as a future work.

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References

[1] Bandura, A. (1971) Social Learning Theory. New York: General Learning Press

[2] Bransford, J. D., Vye, N., Kinzer, C., & Risko, R. (1990) Teaching thinking and content knowledge: Toward an integrated approach. In. B. Jones & L. Idol (Eds.) Dimensions of thinking and cognitive instruction. Hillsdale NJ: Erlbaum. pp. 381-413

[3] Bruner, J. (1966) Toward a Theory of Instruction. Cambridge, MA: Harvard University Press

[4] Chi M.T.H., Bassok, M., Lewis, M.W., Reimann, P. & Glaser, R. (1989) Self-Explanations: How Students Study and Use Examples in Learning to Solve Problems. Cognitive Science, vol.13, pp.145-182

[5] Collins, A.(1991): Cognitive apprenticeship and instructional technology, In: B. Jones & L. Idol (Eds.), Educational values and cognitive instruction: Inplications for refoem., Hillsdale NJ: Erlbaum.

[6] Cooke, N.L., Heron, T.E., & Heward, W.L. (1983) Peer tutoring: Implementing classroom wide programs. Columbus, OH: Special Press.

[7] Cognitive and Technology Group at Vanderbilt. Anchored instruction in science education, In(1992): R.

[8] Davidson, K(1992) : Education in the Internet: Linking theory to reality. http://www.oise.om.ca/kdavidson/cons.html theory and practice., Albany, NY:SUNY Press. pp.244-273

[9] Doise, W. & Mugny, G. (1984) The social development of the intellect. Oxford: Pergamon Press.

[10] Dewey,J. (1916) Democracy and Education. The Macmillan Company.

[11] Endlsey, W.R. (1980) Peer tutorial instruction. Englewood Cliffs, NJ: Educational Technology

[12] Flavell, J. H. (1976) Metacognitive aspects of problem-solving. In L.B. Resnick (Ed.), The nature of intelligence. Hillsdale, NJ: Erlbaum. pp.231-235

[13] Forman,E. A., & Cazden, C. B. (1985) Exploring Vygotskian perspectives in education: The cognitive value of peer interaction. In J. F. Wertsch (Ed.). Culture, communication, and cognition: Vygotskian perspectives. Cambridge: Cambridge Unniversity Press. pp. 323-347

[14] Gagne,E.D. (1985) The Cognitive Psychology of School Learning. Scott, Foresman & Company

[15] Gersten, R., Woodward, J., & Darch,C. (1986) Direct instruction: A research-based approach to curriculum design and teaching. Exceptional Children, vol.53, pp.17-31.

[16] Halpern, D.F. (1984) Thought and Knowledge: An introduction to critical thinking. Psychology Press
[17] http://www.ited.moe.go.th , ITEd project.
[18] Inaba A, Supnithi T, Ikeda M, Mizoguchi R, and Toyada J.(2000) " An overview of "Learning Goal Ontology", ECAI2000 Workshop on Analysis and Modeling of Collaborative Learning Interactions, pp.23-30, Berlin Germany
[19] Lave, J. (1988) Cognition in practice: Mind, mathematics and culture in everyday life. Cambridge University Press.
[20] Lave,J. & Wenger, E. (1991) Situated Learning: Legitimate peripheral participation. Cambridge University Press.
[21] Malamuth,N.M., et al. (1981) Tutoring and Social Psychology. Journal of Educational Thought vol.15(2), pp. 113-123.
[22] Papert, S.(1980): Mindstorms: Children, computers, powerful ideas, Harvetster Wheatsheaf.
[23] Piaget, J., and Inhelder, B. (1971) : The Psychology of the Child. New York: Basic Books.
[24] Resnick, L.B. (1991) Shared Cognition: Thinking as Social Practice.In L. Resnick, J. Levine and S. Teasley. Perspectives on Socially Shared Cognition (pp. 1-22). Hyattsville, MD: American Psychological Association.
[25] Salomon, G. (1992) What Does the Design of Effective CSCL Require and How Do We Study Its Effects? '92 ACM Conference on Computer Supported Collaborative Learning, Vol. 21(3), ACM Press.
[26] Schoenfeld, A. (1987) Cognitive Scien ce and Mathematics Education. Hillsdale, NJ: Erlbaum Assoc.
[27] Spiro, R. J., Coulson, R., L., Feltovich, P. J., & Anderson, D. K. (1988) Cognitive flexibility: Advanced knowledge acquisition ill-structured domains. In proceedings of the Tenth Annual Conference of Cognitive Science Society, Erlbaum, Hillsdale, NJ, pp.375-383.
[28] Spiro, R. J., Feltovich, P., J., Jacobson, M., L., & Coulson, R. L. (1995) Cognitive flexibility, constructivism, and hypertext: Random access instruction for advanced knowledge acquistion in ill-structured domains. http://www.ilt.columbia.edu/ilt/papers/Spiro.html
[29] Supnithi T, Inaba A, Ikeda M, Toyoda J, and Mizoguchi R,:(1999): Learning Goal Ontology Supported by Learning Theories for Opportunistic Group Formation, Proc. of AI-ED'99, pp.67-74, Le Mans France
[30] Vygotsky, L.S. (1929) The problem of the cultural development of the child, II. Journal of Genetic Psychology, vol.36, pp.414-434.
[31] Vygotsky,L.S. (1978) Mind in Society: The development of the higher psychological processes. Cambridge, MA: Harvard University Press. (Originally published 1930)