Conceptual Model of Reflective Collaborative Work System for International Cooperative Project-Based Learning in Engineering Education

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Abstract

This paper is intended to develop the conceptual model of reflective collaborative work system in order to support the process for international cooperative project-based learning in engineering education. Project-based learning aims to engage student in their own learning and to develop the skills of problem finding, decision making, and problem solving. To accomplish these goals, students pursue solutions to authentic problems collaboratively by asking and refining questions, debating ideas, making predictions, collecting and analyzing information, drawing conclusions, and communicating with others. As the various communication tools, especially internet related, support students learning processes and practice, more active and interactive learning activities are encouraged. To support project-based learning efficiently and effectively, well-designed learning and instructional strategies such as explicit goal establishment, scaffolding of the project, expert coaching, providing ample knowledge resources, active and various communication tools, and collaboratively embedded activities among students, are strongly recommended. The reflective collaborative work system to support project-based learning is composed of four supportive parts: work flow management, personal workspace, collaborative workspace, and collaborative reflection.

Keywords: Reflective Collaborative Work System, Project-Based Learning, Collaborative Reflection, Engineering Education

1. Introduction

Project-based learning provides intensive and meaningful experience that evoke students’ interests and aloe for active involvement with both individual and team learning activities. Project-based learning reflects on many educational ideas that focus on human’s interaction with their environment (Gadner, 1993).

By using project-based learning with technology, learners have many opportunities to discover their interest and talents, make connections among different subjects for solving real problems, improvement their social skills and higher order thinking skills, and develop technology skills in their work in school and for their daily life (Fleming, 2000).

The lesson is that since the very invention of network technologies, humans have converted, subverted and/ or transformed network technologies into ways to support and extend human communication, collaboration and community. And educational adopters have played an important role in this history, in transforming cyberspace into social space: emphasizing communication, community and collaboration as the heart of educational networking and collaborative learning (Harasis, 2003).

Educators keep focusing on learning how to use technology in meaningful context; combining educational technology with the need and ability of students and with instructional topics. For the successful technology integration into project-based learning, it is necessary to prepare adequate professional development programs and cooperative learning environments that encourage the appreciate technology skills to empower students.

With this subject in mind, in this paper I present a conceptual model of reflective collaborative work system in order to support the process for international cooperative project-based learning in engineering education. The model can be easily adapted to authentic problems arising in engineering education area.

2. Technical Background

Project-Based Learning

Project-based learning is a form of contextual instruction that places great emphasis on student problem-finding and framing, and which is often carried out over extended periods of time (Laffey et. al, 1998). Project-based learning places demands on learners and instructors that challenge the traditional practices and support structures of schools. Learning from doing complex, challenging, and authentic projects requires resourcefulness and planning by the student, new forms of knowledge representation in school, expanded mechanisms for collaboration and communication, and support for reflection and authentic assessment.

Instructors need help to be coaches and facilitators. Instructors have to act as role models, manage multiple projects, consult in areas of limited expertise, guide with feedback, promote teamwork, recognize and intervene when problems arise (Hawkins, 1995). Learners need support for taking on the whole project, not just carrying out tasks.
assigned by the instructor. They need to draw from their own personal experience and interests, yet fit a project within curriculum objectives and organize the work of the project; they need to collaborate with peers and find mentors, resources, and guidance in order to achieve quality outcomes. They also need to make sense of their results and transform project efforts into valued products and results. The Project-Based Learning Support System (PBLSS) was created to help meet the needs of instructors and learners engaged in project-based learning.

Reflective Collaborative Work System as PBLSS

The reflective collaborative work system as project-based learning is a client/server software application that integrates a number of tools designed to assist learners involved in investigations that closely parallel the work of real researchers. Such investigations take extended periods time and consist of multiple factors requiring diligent attention. They also place strong demands on the cognitive resources of the researcher, and require collaboration; success often depends on skill and experience.

The reflective collaborative work system includes support for two instructional processes and four learning process(Laffey et. al, 1998). The instructional processes are scaffolding and coaching. The learning processes are planning and resourcefulness, knowledge representation, communication and collaboration, and reflection. These processes and the associated PBLSS as reflective collaborative work supports are summarized in Table 1.

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<th>Table 1. Processes of the Project-Based Learner Support Architecture</th>
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(Laffey et.al, 1998, p. 76)

3. Model of Reflective Collaborative Work System for International Cooperative Project-Based Learning Architecture of Reflective Collaborative Work System as PBLSS

The structure operation principle of reflective collaborative work system as PBLSS is in this study are as in Figure1. RCWS is composed of three parts; data base storing quantitative data extracted from work process, knowledge base collecting qualitative information such case, know-how on collaborative learning activities, and reflective collaborative work base offering communication and reflection tool.
Data Base - Resourcefulness

Data base is a space to store information on current project-based learning activities such as learners' interaction, their use of learning resources and their production of results. The information is stored in a fixed form on work flow.

Knowledge Base - Instructional Scaffolding/Coaching

It provides implicit forms of scaffolding and coaching including modeling, giving feedback, structuring the way to do things, challenging the learner, providing hints, encouraging, and providing reminders. The interface of is designed implicit forms of scaffolding around a set of procedures that scaffold the process of doing authentic projects. These processes include setting goals, breaking complex goals down into achievable objectives, planning for these objectives by allocating time for periods of work, and anticipating and planning for the resources that must be available for an objective to be reached. To support this process, coaching is also supported in knowledge base via communicating student work to the teacher in forms that support the instructional decision-making process. The approaches to communication and collaboration that PBLSS implements (discussed later) provide easy, consistent, and rapid access to student work by the teacher. Using an Internet browser the teacher can review the student's work, see previously made comments, and leave new comments. Thus, PBLSS helps represent student work and changes in it in ways that are easy for the teacher to access and understand, and which facilitate the coaching process.

Reflective Collaborative work Base – Planning/Representation/Communication/Reflection

Planning Tools provides the complexities of real task by offering organizational and management tools for project planning. Since a project is not a scripted task, planning tools need to be open ended and enable modification and redirection. Thus it provides tools for specifying broad goals, for specifying sets of objectives and associated time-lines that are steps to be accomplished in the meeting of those goals, and for specifying and associating resources that must be available if the objectives are to be met.

A representation, once created, becomes a cognitive artifact and can function as a tool for thought. Transferable from one learner to the next, or from one context to the next, a representation can act as a lens to focus and guide inquiry. The process of creating most artifacts, which we take to be synonymous with the act of representation, requires a number of cognitive processes to occur. Representation tools supports knowledge representation by helping learners organize their thoughts into an analogue of a journal article that includes sections for an abstract, a statement of project goals, a listing of specific objectives, project timelines, the resources needed to accomplish objectives, specification of the project team and responsibilities of the members, and an applications/extensions section in which they may draw conclusions from their work and make suggestions for further inquiry.

Communication tools include asynchronous communication tools and functions to check learners' states of the progress of tasks and the connection of team members. The task workplace includes functions for preparing tasks, individual learning, team learning, and task evaluation. The learning resources include lecture contents and reading materials. Learning tasks are designed to produce research reports and team outcomes while each team executes inquiry-based learning and project-based learning on theme.

Reflection tools supports reflection by requiring learners to articulate their work, by facilitating comments and critiques from others, and by making it easy to review and compare previous work. By having several discourse and collaboration channels, it increases the likelihood that the learner's articulation will be reviewed and critiqued, thus encouraging further reflection. It provides for reificative reflection by tracking and storing every made to a part of the project team's documents from the beginning of a project to its end. This kind of "reflection" enables a learner to reflect
in a systematic way on the problem-solving process, and to reach new conclusions or make elaborations they might otherwise not have. Reflective reflection brings powerful cognitive forces into play. Learners examining their own work and comparing it to that of others, to their own later work, or to a cognitive model, must organize information, elaborate upon concepts, and integrate ideas from potentially many sources.

4. Conclusion
The reflective collaborative work system as PBLSS is an attempt, through a collaborative design process with instructors and students, to develop tools and structures for doing projects that make student outcome more likely. Through continuously cyclic design and revision, reflective collaborative work system is becoming a valuable support tool in engineering education.

To support reflective collaborative work for cooperative project-based learning in engineering education efficiently and effectively, well-designed learning instructional strategies such as explicit goal establishment, scaffolding of the contents of the project, expert coaching, providing ample knowledge, group communication tools, and collaboratively embedded activities among learners, are strongly mended. The conceptual model of reflective collaborative work for international cooperative project-based learning will provide an environment for studying authentic learning, the processes of doing projects, and the structures needed for their support.

References
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Biography
She received M.S. in industrial education from Yonsei University, Seoul, Korea, in 2002 and Ph.D. in Educational Technology, from Hanyang University, Seoul, Korea, in 2005. She is currently Research Professor in the Research Center for Engineering Education at Sogang University, Seoul, Korea. Her main research interests include engineering education, quality assurance support system, reflective collaborative learning, project-based learning.