A Collaborative-learning Support Function to Harness Organizational Intellectual Synergy

Hiroyuki Tsumoto, Yusuke Hayashi, Mitsuru Ikeda, Akiko Inaba, and Riichiro Mizoguchi
The Institute of Scientific and Industrial Research, Osaka University
8-1, Mihogaoka, Ibaraki, Osaka, 5670047, Japan

Abstract

Intellectual synergy is a major source of high competitive power for an organization. Through our research project, we have been developing an environment, Kfarm, to support creating/inheriting organizational intellect. Characteristic features of Kfarm include a Dual Loop Model which represents ideal processes of knowledge-level communication among personnel to create/inherit organizational knowledge. In this paper, we focus on collaborative learning support functions of Kfarm. This research seeks to clarify the essential role of collaborative learning in an organization and provide an appropriate opportunity for collaborative learning for organization members. Attaining the goal requires construction of a design model of collaborative learning and realization of design support functions into Kfarm. This paper first introduces learning aspects of organizational activities. Then, it roughly outlines Kfarm while focusing on collaborative learning support functions.

1: Introduction

Intellectual synergy is a major source of high competitive power for an organization. To increase that power, it is very important to implement reasonable integration of various types of activities [1]. This research considers the following three aspects of knowledge creation and inheritance activities.

- Individual activities or Group activities
- Top-down or Bottom-up
- Practical or Educational

The first aspect distinguishes between personal and group activities. The second distinguishes activities whose purposes are established based on the organization's vision or strategy and activities at the organization members' own initiative. The third distinguishes practical and educational activities. The goal of practical activities includes to eventually produce novel and significant intellect for an organization. The educational goal is to properly transmit significant intellect from past to future members of an organization. Educational activities mean those which are simplified and separated from the practical context with educational goal.

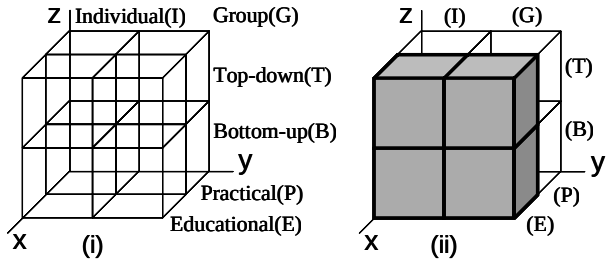

Figure 1. A classification of learning

Each aspect does not always mean exclusive distinction among activities. For example, OJT (On the Job Training) is carried out with both practical and educational goals. Figure 1(i) shows the classification of activities in an organization by projecting these aspects to axes of three dimensions.

One main purposes of this study is to support "Learning" in an organization. Generally the term "Learning" indicates the typical concept of learning that is established as part of the social system of education. On the other hand, researchers, who are interested in the integration of various forms of learning, for example, workplace learning, life-long learning, organizational learning, collaborative learning and so on, refer to the term "Learning" in a wider sense [10], [11]. In Fig. 1, the former corresponds to educational activities shown as the shadowed part of Fig. 1(ii); the latter corresponds to the entire cube.

Most studies on computer supported learning aim at the former interpretation of "Learning". For example, Watanabe and Kojiri arranged various kinds of educational support systems, CAI, CAL, ITS, and CSCL, according to the SECI model; they proposed a learning environment architecture in which learners are able to freely change their learning style [7], [8]. This study addresses that educational viewpoint, but ignores other aspects. Fischer's Life-long Learning [3] aims at reforming learning space by information technology, approaching learning in a wide sense as learning activities at a practical workspace over a long period. Along a similar line of thought, the final purpose of our study is to build a framework to support learning intelligently in a wide sense.

Through our research project, we have been developing an environment, Kfarm, to support creating/inheriting organizational intellect. Characteristic features of Kfarm include a Dual Loop Model (DLM) which represents ideal processes of knowledge-level communication among personnel to create/inherit organizational knowledge. In [4], [5], we proposed that DLM implies that most knowledge-oriented activities in an organization can be regarded as "learning" in the wide

sense. In this paper, along a similar line of thought, we focus on collaborative learning support functions of Kfarm and seek to clarify the essential role of collaborative learning in an organization and provide an appropriate opportunity for collaborative learning for organization members. Attaining the goal requires construction of a design model of collaborative learning and realization of design support functions into Kfarm. This paper first introduces learning aspects of organizational activities. Then, it roughly outlines Kfarm while focusing on collaborative learning support functions.

2: Model-based support of collaborative learning in an organization

2.1: An aspect of collaborative learning

In addition to three aspects discussed above, we introduce another to characterize collaborative learning. It distinguishes between less-regulated and well-regulated collaborative learning. The former mostly addresses collaborative learning with less-clear goals. A typical communication mode in less-regulated collaborative learning is opportunistic document exchange in practical work. On the other hand, the latter mostly orients to collaborative learning whose features, i.e. participants, roles, goals, etc., are shared in advance by participants. A typical way of communication in well-regulated collaborative learning is a discussion on a certain practical problem to be solved in the organization. Learning space goals fit the organization needs if the learning space goals and participants' roles are appropriately established following an organizational vision/strategy. Actually, people are engaged adaptively with both aspects of learning activities through our daily work.

Our goal is to lay an IT foundation for designing the reasonable arrangement/integration of both aspects of collaborative learning space. If the goal of a collaborative learning activity is, for example, to evaluate a new idea created in a certain domain, then participants from a different domain related to the idea may be expected to actively join discussion , in addition to domain experts, and evaluate it from a different viewpoint. In this case, free discussion through less-regulated collaborative learning is helpful for participants to increase mutual understanding of the topic in advance of a goal-intensive discussion in a well-regulated learning. In such a case, less-regulated collaborative learning acts as a foundation of well-regulated collaborative learning; also, the well-regulated learning properly directs less-regulated learning.

However, it is difficult for the organization to grasp the state of organizational intellect; it is also quite hard to set up a reasonable collaborative activity due to lack of design principle. Thus, an organization might miss an opportunity to set up a good collaborative learning space. Keys to implement better arrangements include affording a good awareness of intellects [12] and establishing a design principle [9] based on the awareness.

This paper considers supporting functions for both less-regulated and well-regulated collaborative learning. In a less-regulated collaborative learning, it is important to support both intellect exchange and sharing awareness of intellect in an organization by providing awareness information for organizational members. In a well-regulated collaborative learning, it is important to support established learning space conditions, e.g., participants and their roles. The Kfarm, which we have been developing, enables us to construct a better learning space for creation and inheritance of organizational intellect by integrating the two aspects of collaborative learning.

2.2: Models for supporting creation and inheritance of organizational intellect

Organizational members act for practical and educational goals as discussed in 2.1. They achieve these goals through communicating intellect as described below.

- Acquiring intellect from inside and outside of the organization.
- Creating new intellect.
- Distributing an individual's own intellect throughout the organization.

Linking these activities are vehicles such as conversations, books, or documents. Organization members are aware of others' intellect interpreted from other's activities and vehicles; they usually do various activities to achieve creation and inheritance of organizational intellect based on awareness. Such individual activities govern the organization. However, members are aware of their own intellect and the others' only with difficulty; they determine activity to attain goals due to an implicit ideal process of creation and inheritance of organizational intellect and content of the vehicles actually used in activities. Consequently, in order to be aware of intellect and decide activities to attain a goal, a model must be clarified which represents relations among an organization, individuals, intellect, vehicles, and activities from the view of creation and inheritance of an organizational intellect.

Nonaka et al. proposed the SECI model, which represents a knowledge-conversion process and "Middle up-down management", which is a form of an organization to activate the process [2]. In Middle up-down management, a "Knowledge practitioner (K-practitioner)" plays the role of generating the creative power mentioned above, while a "Knowledge producer (K-producer)" plays the role of coordinating the top's visions and K-practitioners' practical activities. Typical K-producer activities are:

- Properly understanding organizational conditions.
- Setting up a well-regulated collaborative workspace for creating or refining intellect, e.g. meeting.
- Assimilating new intellect with the organizational knowledge.
- Distributing organizational intellect based on their vision/strategy.

K-producers orient K-practitioner tasks through these activities.

This study displays a model of an ideal abstract

process of creation and inheritance of organizational intellect from both practical and educational perspectives; we aim at supporting these processes by intellectually capturing the actual process based on the model. Designing an model-based environment enables the information system to grasp K-practitioner activities through the environment; it also provides intelligent functions according to the organizational state.

2.3: Designing a system based on models

We have modeled an ideal abstract process of organizational intellect creation and inheritance as a "dual loop model". It describes relational constraints between activities and states/properties changes of the intellect. It is a reference model for designing the information system and is used as a basis of a data model.

Most document management systems manage documents with indexes. However, it is difficult to share them in an organization since index meaning is implicit and does not ensure consistency. Even if the document is shared, that will often be done on an implicit premise. To share and inherit intellect in an organization properly, it is necessary to form a basis to clarify the meaning of intellect.

Ontology has been brought to public attention as a foundation of knowledge modeling. Ontology is a set of definitions of concepts and relationships among them. Concepts related to tasks and domains of an organization are defined as an ontology to describe document content. This construct not only helps K-practitioners and a K-producer; it also makes information systems aware of intellect concerned with a document. The description is called the "conceptual index". Thus, content of intellect in an organization is modeled with an index described on the basis of the ontology.

The information system performs intelligent functions to grasp activities and contents of organizational intellect based on the dual loop model and ontology. The supporting system, Kfarm, is designed based on these models. Kfarm facilitates creation and inheritance of organizational intellect since Kfarm gives users some support functions according to the process represented by the dual loop model. Kfarm makes a model of a person and a model representing chronological correlation among persons, activities, and intellect in an organization called an "Intellectual Genealogy Graph" (hereinafter referred to as IGG) [6]. It provides support according to the state of organizational intellect, through which these models help the system and users to increase understanding.

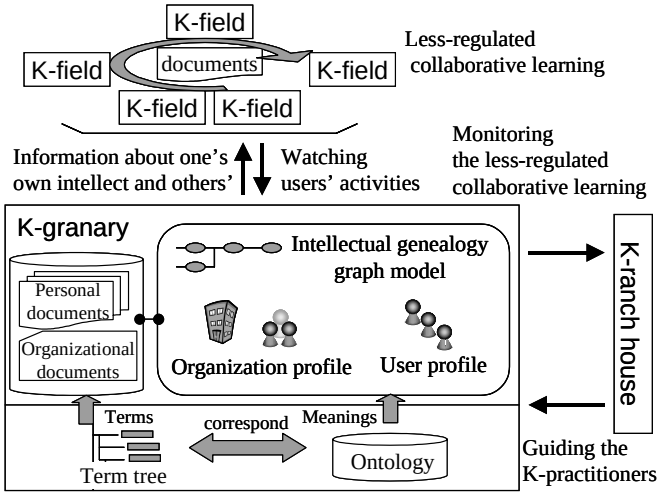

Fig. 2. A Kfarm overview

3: Kfarm : a system of supporting creation and inheritance of the organizational intellect

3.1: An overview of Kfarm

Figure 2 shows the block diagram of Kfarm. Kfarm is a distributed system consisting of a K-granary, at least one K-ranch house, and some K-fields. The K-field and K-ranch house are environments for a K-practitioner and a K-producer respectively. The K-granary is a server of the organizational memory.

A K-field plays the role of a workspace of both a less-regulated and a well-regulated collaborative learning for K-practitioners. It is a Web-browser-like environment for K-practitioners to carry out knowledge-oriented collaborative learning activities: searching, creating, organizing, and communicating information described in 2.3. In order to support these activities, the K-field provides the functions of sorting and searching K-practitioners' documents, and distributing them to others. It also presents information concerning awareness of others and documents related to the K-practitioner's interest. Through exchanging documents by K-practitioners, a less-regulated collaborative learning space is formed on K-fields. As aids to communication, the K-fields provide bulletin board, chat, and mail services for K-practitioners. These functions also help K-practitioners to converse in a well-regulated collaborative learning space.

The K-granary stores and delivers K-practitioners' or an organization's documents to the K-field and the K-ranch house. In addition, it builds a model of an organizational intellect as a combination of a process model and content model: that is to say, the dual loop model and the ontology. The model is the IGG mentioned above. It represents an interpretation of organization member activities. It is modeled based on the dual loop model by abstracting activities observed in each K-field. In this regard, the K-field serves as a sensor observing users' activities. The IGG supports role clarification for each member from a trail of his/her intellectual activities in an organization. We call that role an "intellectual role", which characterizes a contribution of a person in the organizational intellect construction process. The intellectual role gives helpful information to a K-producer for designing a space for collaborative learning as described later. Moreover, based on the IGG, the K-granary recognizes a meaningful organizational intellect growth sign. The sign is then imparted to a

K-producer through a K-ranch house.

On the K-ranch house, the sign is given for the K-producer with information about the organizational intellect state. Seeing this information, the K-producer chooses a correct way to facilitate organizational-intellect creation and inheritance activity in the less-regulated or well-regulated space. The K-ranch house supports the K-producer's activities: assimilating/ distributing a new intellect, coordinating communication, and assisting in collaborative learning of K-practitioners. The former activities support less-regulated collaborative learning while the latter support a well-regulated collaborative learning. We next focus on these aids to collaborative learning and describe how the K-ranch house helps the K-producer guide K-practitioners in creation and inheritance of organizational intellect.

3.2: Less-regulated collaborative learning support on the Kfarm

The K-ranch house shows a K-producer and K-practitioners' activities captured in a K-field. That helps K-producer to understand the organizational state. The K-ranch house also provides a K-producer with tools to maintain an organizational library and distribute organizational intellect. The organizational library is a document library maintained systematically and shared throughout the organization. Significant documents for organization are stored in the organizational library with conceptual indexes.

To help a K-producer to distribute documents, the K-ranch house shows K-practitioners who are related to each document. This indication is based on interpretation of the activities captured in the K-fields and K-ranch house.

3.3: Well-regulated collaborative learning support on the Kfarm

A K-ranch house helps a K-producer to design a well-regulated collaborative learning space such as a meeting. The K-producer designs a space by assigning certain values to properties shown in Table 1.

Property	Explanation
Purpose	A purpose to be achieved through collaborative learning space.
Role	Roles participants play to achieve the purpose.
Topic	Subjects discussed in the collaborative learning space.
Group	Participants in the collaborative learning space.
Space	A space where discussion is held -- bulletin boards, chats, and meeting rooms.

Table 1. Properties of a well-regulated collaborative learning space

For good learning space design, designers must properly refine the desired rough goal broken into specific subgoals; then, the designer arranges learning spaces in which he/she can achieve them. It is, however, not generally easy for the designer to accomplish these tasks because their guidelines are implicit. To reduce difficulty, the K-ranch house provides two pattern types for guidelines: structure patterns and flow patterns. The structure pattern represents patterns of learning space structure which are expected to achieve the purpose; they describe typical relations between collaborative learning purposes and participants' roles. The flow pattern represents learning space flow to achieve a goal. It consists of some sequences of structure patterns. Table 2 shows an example of a structure pattern. "Type" is either practical or educational; it represents the feature of the learning-space purpose. A practical pattern aims to solve a practical problem and an educational one aims to foster participants. We design the structure patterns by considering learning theories. We construct an ontology which indicates collaborative learning efficiency [13]. "Theory" in Table 2 shows the theory which we refer to.

The K-ranch house supports design using these patterns and IGG made from Kfarm user activities. Here, we show a part of a design environment in which a K-producer decides participants and their roles; we then describe an example of environment support functions.

Name			Refining an intellect
Type			Practical
Role			
	Collaborator from another domain	Condition	Acquainted with the intellect
		Behavior	Develop intellect
		Interaction purpose	Question, make an idea, answer
		Personal purpose	Amplify the intellect
Group purpose			Amplify the intellect
Theory			Distributed Cognition

Table 2. An example of structure patterns (Partially simplified)

Figure 3(A) shows an editor window screenshot of participants and their roles. Figure 3(C) is a window assigning roles to participants. Figure 3(B) displays a visualized IGG which indicates a history of intellect generation. Figure 3(B-1) is a person who has an intellect related to collaborative learning subjects. The IGG provides a good foundation for choosing participants since it helps the K-producer to grasp who is appropriate for the subject of collaborative learning. In the assignment window, the K-ranch house recommends participants based on the intellectual role in the IGG and the property "role" in the structure pattern. In the example, for the role of "generating new ideas", the K-ranch house recommends the person (Fig. 3(B-2)) who created a seed document of the intellect related to the subject (Fig. 3(B-1)). Thus, it helps the K-producer to decide participants and their roles by providing information about

the history of intellect generation and candidates for participation.

4: Conclusion

In this paper we have discussed integration of various activities in an organization as "learning" in a wider sense; we proposed Kfarm as a framework of an information system to support "learning". We view the organizational intellectual activities as collaborative learning and modeled it according to the two perspectives: less-regulated and well-regulated. Kfarm provides environments supporting collaborative learning from both aspects. In a well-regulated collaborative learning space, it is important to clarify collaborative learning purposes and the participants' roles, and learning subjects. We proposed structure patterns and flow patterns as guidelines for collaborative learning design; we then designed an environment to support learning space design based on these patterns.

Future direction of this study will be to enrich structure and flow patterns which combine both practical and educational aspects. The example of structure patterns described in this paper is organized from the latter aspect, but we have been developing patterns adapting both aspects to grasp all organization activities discussed in Chapter 2. Concerning the educational aspect, we aim to design rational patterns ensuring consistency and conformance based on the collaborative learning ontology we formulated [13]. Additionally, we will construct a human resource model of an organization to empower dynamic group formation for collaborative learning as described in this paper by taking a static organizational hierarchy in consideration.

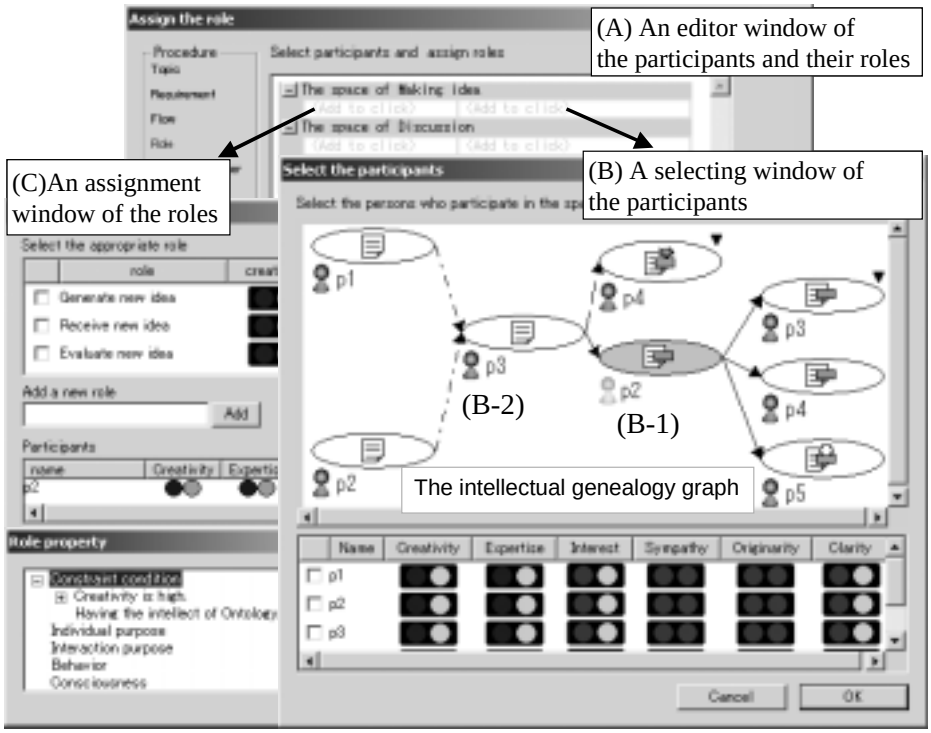

Figure 3 K-ranch house (under development)

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