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# Using Ontology for Representing Role Change Design in Nursing Service Thinking Education

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**Abstract:** This study aims to develop a learning design representation framework to support the modelling of an in-service education program for fostering the meta-thinking skill of nurses. In this paper, we describe the development of the ontological framework for representing the design intention of the learning goals of the meta-thinking skills and also the relationship of the learning experiences gained from changing leaner's roles.

**Keywords:** instructional design, ontological engineering, metacognition, nursing service education

## 1. Introduction

In the social constructivist view of education, the focus of learning transfers from knowing facts and procedures to acquiring knowledge and skills for solving the authentic, contextual and social problems which do not always have a clearly correct or universal answer. The characteristics of these problems are that i) they can be formulated or defined from various perspectives; ii) their solution is not unique, and the criteria for choosing a better solution is implicit or situation-dependent (Munneke, et al., 2007).

Nursing education is one of the forefronts of the professional education areas which aim to foster the abilities for solving the patient related problems. To acquire these problem solving abilities, it is crucial to acquire implicit knowledge and skills based on the experience of reflecting on one's own thinking. Various educational methods, including narrative method and reflective journal have been conducted in the professional education of nurses in order to support the learning of these knowledge and skills (Bulman, 2013).

In this research, we focus on the design of meta-thinking skills education. The terminology "meta-thinking" is a particular concept. The meta-thinking skills are defined as the skill of monitoring and control of thinking which targets to clarify beliefs behind the conflicts of different perspectives. Compared with the concept of Dewey's reflective thinking, the meta-thinking is the narrowly-defined concept that focuses on the careful consideration of belief clarification. We consider that improving the nurse's meta-thinking skills is crucial to build the foundation for the patient-centered medical service. For example, in the realistic setting of medical service, the patients have a tendency to lie to the doctors for protecting the private information. On the contrary, the doctors want to know more information for diagnosis. It is helpful to improve the meta-thinking skills for promoting the quality of medical service with due consideration of the rationality of medicine and the patients' humanity.

For supporting the design of learning goals, learning content and education methods, various theories (Gagné et al., 2004; Keller, 2009) and techniques (Hayashi, 2004; Paquette, 2006) have been studied. For example, Hayashi et al. (2009) proposed an ontology-based

theory-aware and standards-compliant authoring system to provide a general knowledge-base for linking educational theory and practice.

However, it is difficult to create a clear model for education which targets the fostering of experientially-acquired skills (especially thinking skills). This study aims to develop a learning design representation framework which supports the modelling of meta-thinking skills education for nursing services. This paper describes the development of an ontological framework for representing the design intention of the learning goals of the meta-thinking skills and also the relationship of the learning experiences gained from changing leaner's roles. The entire ontological framework built through the study will be reported separately.

## 2. Education Program for Fostering Meta-thinking Skills

An education program named Nursing Service Thinking Method Workshop was designed to foster nurses` meta-thinking skills. The educational objective is that, through building the skill of the thinking representation (identification of thinking logical structure), nurses are expected to 1) understand both of examining their own thinking and considering about other's perspective through identification of thinking logical structure; and 2) to be motivated to continue to learn meta-thinking skills by themselves after the end of the education program (Cui et al, 2014).

As shown in Figure 1, the workshop consists of six parts: Lecture, Case-writing Practice, Case-writing (homework), Case Reviewing, Discussion and Reflective Lecture. It is conducted in 2 day-long sessions spaced approximately one month apart; the workshop is conducted three times per year. It is also necessary for the leaners to attend the entire program of the workshop for three years, because they need to change their role after learning in the workshop for each year.

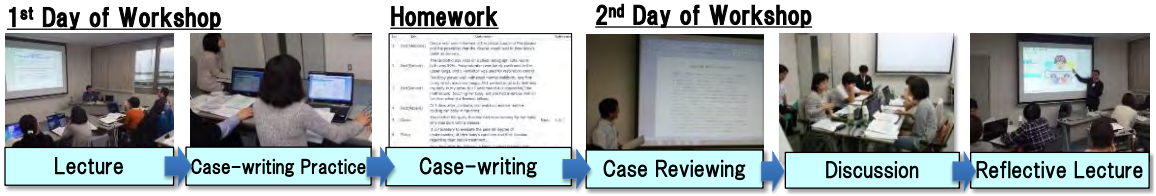


Figure 1. Overview of Nursing Service Thinking Method Workshop

### *2.1 The Characteristics of the Workshop*

a. Using a Reflective Case-writing Supporting Tool named Sizhi (Figure 2) as the core learning material for improving the quality of thinking reflection through the support on the identification of thinking logical structure (Chen et al., 2011).
b. A form that combines the self-thinking reflection experience from case-writing and the group-thinking reflection experience from discussing the case with other learners to help participants recognize the connections between those two kinds of experience and promote the acquisition of meta-thinking skills.
c. A step-by-step learner's role designed to utilize the learning experience from the previous step to trigger the useful learning experience in the successive step to promote the acquisition of meta-thinking skills. The definitions of the leaner's role are:

   Member (1st Year Attendance) attends six sessions of the workshop, acquires fundamental knowledge and skills related to thinking representation logical thinking.

   Leader (2nd Year Attendance) attends the case-writing practice session and the discussion session. In the discussion, the Leader does not take the initiative in presenting a viewpoint but views discussion from the higher perspective and guiding it. Based on the experience of learning in the role of a Member, monitoring and controlling of group thinking skills can be promoted.

Facilitator (3rd Year Attendance) does not attend the workshop but supports the learning of members through revising and giving comments to the cases written by members (Nishiyama et al., 2014).

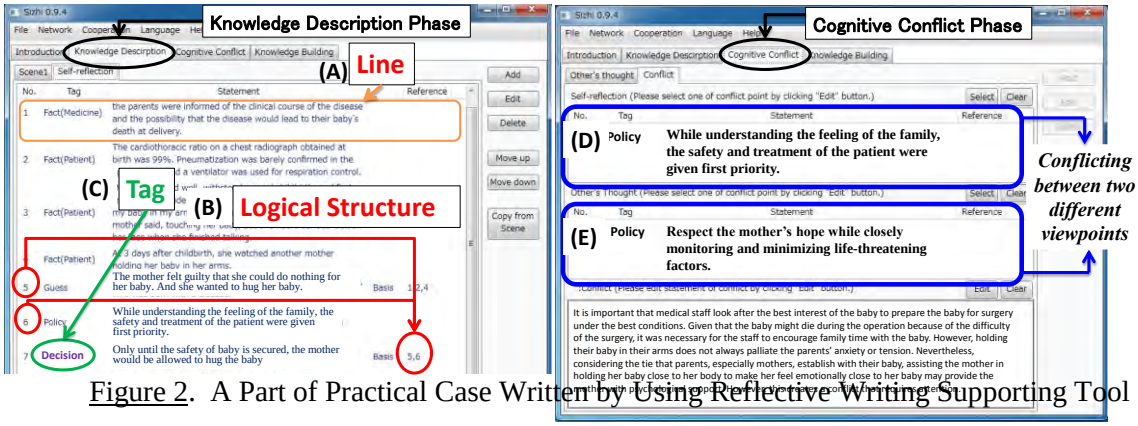


Figure 2. A Part of Practical Case Written by Using Reflective Writing Supporting Tool

Before changing becoming a Leader, a Member needs to attend the workshop three times in one year to acquire fundamental knowledge and skills from their learning experience. Some of the learning experiences Members undergo are implicitly designed to promote further learning as a Leader. This relationship of learning experiences is an important design aspect of the learning of meta-thinking skills.

## 3. Ontology-base Representation Framework

In order to represent the implicit design intentions mention above, we develop a learning design representation framework that consists of the graphic representation form and the ontology representation form. The graphic representation form can provide a descriptive medium to represent the elements of learning design such as learning goal, learning strategy and etc. The merit of the graphic form is that it can marshal the different elements of learning design in a structured way. The ontology representation form is created for representing the learning design intentions in a further precisely and systematically, which is difficult for the text or graphic representation from to be done.

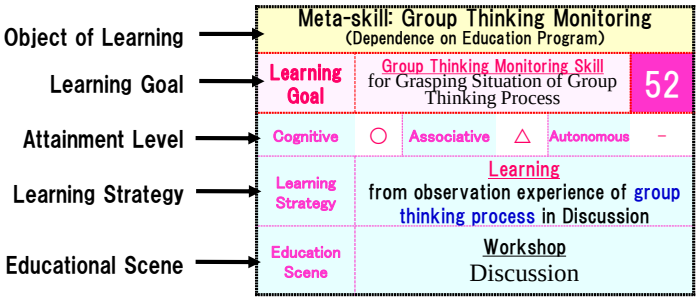


Figure 3. An Example of Learning Unit

An example of the basic form of the graphic representation is shown in Figure 3. The whole of the box in the figure is named Learning Unit. The learning unit is created for integrating the concepts related to the design of the education program, including Object of Learning, Attainment Level of Learning, Learning Goal, and Learning Strategy. The row that represents Learning Goal states the goal which the learning unit aims to achieve. The content in the row that represents Object of Learning refers to the kind of skill, knowledge or attitude. The content in the row that represents Attainment Level indicates the attainment level of learning on the object of learning. For example, the learning unit shown in Figure 3 indicates that the learners are expected to achieve the learning goal "Group Thinking Monitoring Skill for Grasping Situation of Group Thinking Process" to the attainment level of "Cognitive", by the learning strategy learning from observation of group thinking process in discussion. The Group

Thinking Monitoring refers to the realization of group thinking condition through analyzing and evaluating the process of group thinking. The level of Cognitive means knowing fundamental knowledge or knowledge on how to practice skill. Moreover, the learning goal is not independent but a part of a continuous learning process which regards the program dependence meta-thinking skill of "Group Thinking Monitoring" as the Object of Learning. This implies that this skill is intended to be acquired gradually within the program through several steps.

By using the learning unit described above, the learning design of the workshop can be organized and represented in an easily viewable way. In addition, the learning experience gained from what kind of Member's activities influence which part of Leader's learning can be represented. For example, in Figure 4, the learning unit on the left side represents the member's learning experience gained from externalizing the result of logical thinking in Sizhi. The learning unit on right side represents the leaders' learning on the meta-thinking skill through attending and observing the discussion. One of the purposes of the case-writing is to help the participants become aware of the logical structure of thinking by externalizing his/her thinking. This awareness also benefits the discussion, because this awareness is expected to trigger the action of realizing the logical structure of group thinking process.

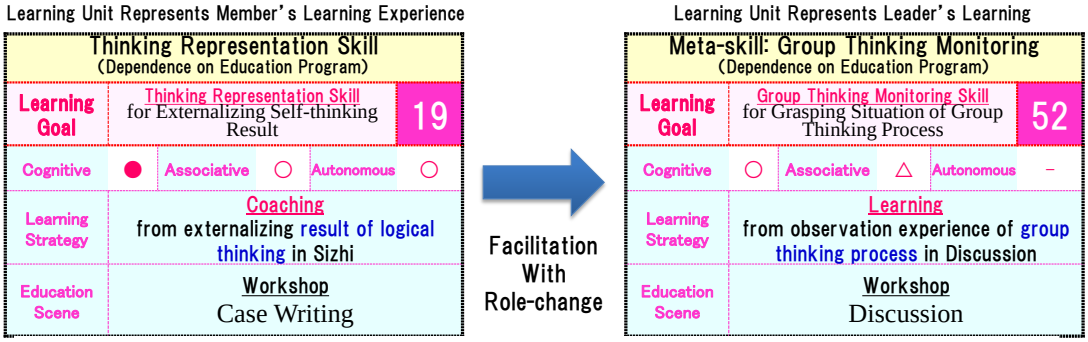


Figure 4. An Example of Relation between Member's Experience and Leader's Learning

In this research, we use the Hozo ontology editor (Hozo Ontology Editor) to build the representation framework (Chen et al, 2014). The most significant feature of the Hozo ontology editor is that it provides a function to support users to build ontologies being aware to distinguish role concept from basic concept (Mizoguchi, et al, 2007). For example, in schools, the teacher role is set up and the person who is assigned the teacher role is considered as a teacher. In this example, the person is basic concept and the teacher role is role concept. The concept of teacher is named role holder. This feature is practical to explore and represent the essence of the concept which is always easily-confused.

The ontology related to the facilitation by experience is shown in Figure 5. A~E of the figure indicates the concepts in a hierarchy. The concepts in upper levels (such as A) represent more general concepts; lower levels (such as E) represent more specific concepts. E shows a specified concept of Facilitation by Experience with Role-change (FER) named FER of Member's Case-writing Experience to Lead's Learning in Discussion. As described in Figure 4, the member's experience of coaching from externalizing result of logical thinking in Sizhi is expected to be helpful for facilitating the leader's learning conducted with the learning strategy of Discovery from observation of group thinking process in Discussion. By using ontology, this influence can be represented. Because the role change in this example is from member to leader, the pro-role is restricted with concept of member [RH] (e1) and Target role is restricted with the concept of leader [RH] (e2). RH means role holder according to the ontology theory that Hozo is based on. In the workshop, the person who is assigned the member role is defined as member [RH] and the person who is assigned the leader role is defined as leader [RH].

In the learning experience (e3), the attributes of member [RH] as the holder (d4) and Identification on logical structure (e5) to self-thinking result (e6) as the outcome are defined.

The meaning of this definition is that the action identification on the logical structure of self-thinking result is involved in the member's learning experience of coaching from externalizing result of logical thinking in Sizhi. Similarly, in the learning strategy (e7), the attributes of leader [RH] as the holder (e8) and Identification on logical structure (e9) to group thinking process (e10) as the action are defined. The meaning of this definition is that the action identification on the logical structure of group thinking process is involved in the leader's learning conducted with the learning strategy of Discovery from observation of group thinking process in Discussion.

The relation same-person (R1) between Pre-role and Target-role represents that the same person plays the different role in the workshop and role-change is conducted from Pre-role to Target-role. The relations sameAs (R2 and R3) mean that the learning experience belongs to the person who is assigned the member role and the learning strategy belongs to the same person who is assigned the leader role.

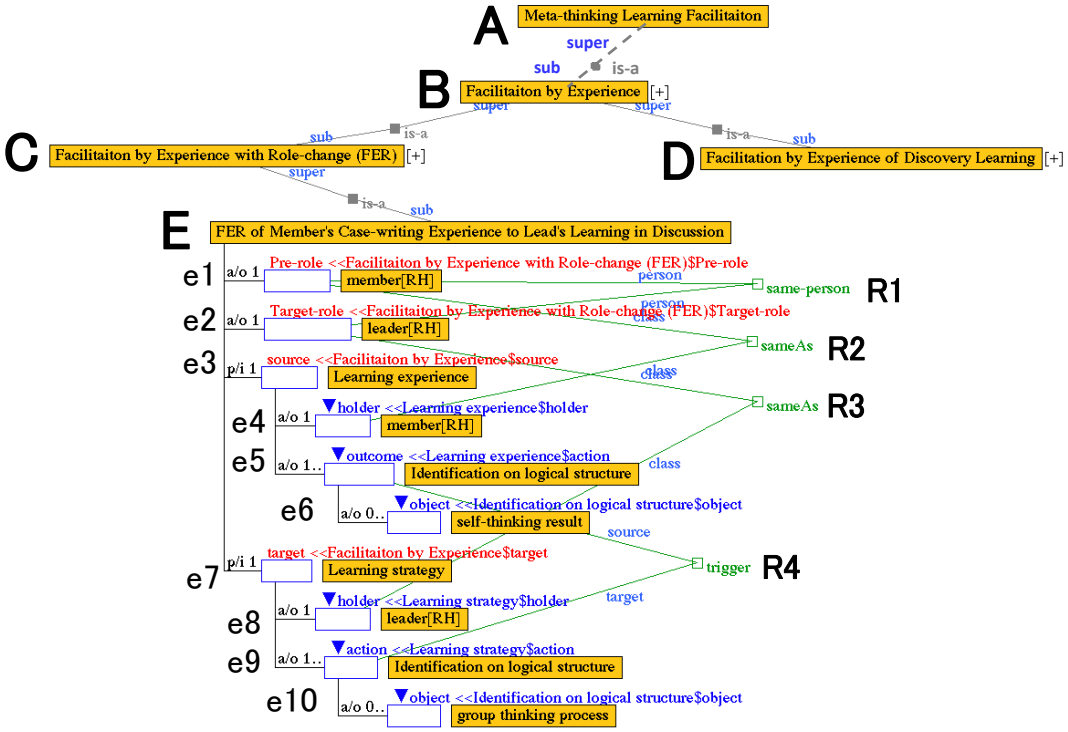


Figure 5. Ontology related to Role Change (Part)

By defining the concepts of learning experience and learning strategy, it is represented that the concepts of Identification on logical structure (e5) and Identification on logical structure (e9) have the same name, but the meaning of these two concepts are different, because they play different role for the concepts which they belongs to. Furthermore, the relation of e5 and e9 is indicated with the relation of triggering (R4). It represents how an outcome of the member's learning experience from the case-writing influence the leader's learning.

As described above, by using ontology, the implicit relation of learning experience is represented. Although the learners will not use the ontology directly, representing the learning design by ontology is useful to encourage the designer to consider about the improvement. For example, in leader's learning, it is necessary to help them to realize the similarities and differences of self-thinking and group thinking and to support their conduct of the action Identification on logical structure in the discussion.

## 4. Conclusion and Future Work

The meta-thinking skills are difficult to facilitate but crucial for the nurses, because it is important to reexamine and integrate self-thinking, the thinking of patients and the thinking of

co-workers and other healthcare professionals through the dialogue with self and other people to achieve high-quality patient-centered medical service. We have been working on this practical research in collaboration with medical institutions. This study is intended to create a foundation for the process of design, implementation and redesign for the educational practice in nursing service. For facilitating meta-thinking skills, besides the design of the role change model described in this paper, we are creating several other models. In this study, the circulating procedures of model creation, ontology construction through segmenting the concepts, and the refinement through practice are conducted repeatedly. The workshop is designed as one turn in three years and the current research is at the stage of completion of former two years. Using this representation framework is helpful to share the design intentions of the meta-thinking skill fostering workshop which is conducted in a long term. We are currently working on the creation of the facilitator's educational model and its application. In addition, we plan to reorganize and report the overview of the entire model after completing other parts.

In summary, the graphic and ontological representation framework is used in the design and creation of textbooks and exercises in the implementation of workshop, in the development of evaluation methods and even for sharing the design intentions between the people who are in charge of different parts of learning design cycle. The feedback from those practical learning design activities is positive. In the future, we will develop a supporting tool for sharing the design intentions to the learners to help them to realize the learning goals. Furthermore, we will also study the supporting tool for assisting the facilitator role learners to improve or customize the workshop according to the demands of their medical institutions.

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