



Published online: 3-13-2014

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Rintaro Imafuku

*Gifu University*, [rimafuku@gifu-u.ac.jp](mailto:rimaryfuku@gifu-u.ac.jp)

Ryuta Kataoka

*Showa University*

Mitsuori Mayahara

*Showa University*

Hisayoshi Suzuki

*Showa University*

Takuya Saiki

*Gifu University*

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### Recommended Citation

Imafuku, R. , Kataoka, R. , Mayahara, M. , Suzuki, H. , & Saiki, T. (2014). Students' Experiences in Interdisciplinary Problem-based Learning: A Discourse Analysis of Group Interaction. *Interdisciplinary Journal of Problem-Based Learning*, 8(2).

Available at: <http://dx.doi.org/10.7771/1541-5015.1388>

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# THE INTERDISCIPLINARY JOURNAL OF PROBLEM-BASED LEARNING

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## ARTICLE

### Students' Experiences in Interdisciplinary Problem-based Learning: A Discourse Analysis of Group Interaction

Rintaro Imafuku (Gifu University), Ryuta Kataoka (Showa University), Mitsuori Mayahara (Showa University),  
Hisayoshi Suzuki (Showa University), and Takuya Saiki (Gifu University)

Interdisciplinary problem-based learning (PBL) aims to provide students with opportunities to develop the necessary skills to work with different health professionals in a collaborative manner. This discourse study examined the processes of collective knowledge construction in Japanese students in the tutorials. Analyses of video-recorded data elicited from three multidisciplinary cohorts and their learning portfolios provided insights into their participation and introspection during the discussions. The results indicate there were two patterns of knowledge construction: (a) co-constructions between students from different disciplines and (b) elaborations between students from the same discipline. Their learning processes were mediated by their cultural assumptions, professional identities, understanding of other professionals, and perceptions of collaborative learning. The finding suggests that interdisciplinary PBL has the potential to enhance students' collaborative learning skills, and students' participation is situated within a cultural context.

*Keywords:* Interprofessional education, health professional education, social interaction in PBL, reflective learning, classroom discourse analysis

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## Introduction

The focus of this study is on examining undergraduate students' participation and reflection on learning experiences in an interdisciplinary problem-based learning (PBL) tutorial in the context of Japanese health professional education. PBL is a learner-centered approach "that empowers learners to conduct research, integrate theory and practice, and apply knowledge and skills to develop a viable solution to a defined problem" (Savery, 2006, 12). Interdisciplinary PBL is part of interprofessional learning to develop mutual professional respect and trust, which is essential in patient-centered practice. In this PBL, each student needs to take an interactive approach to learning in order to construct knowledge among the different professionals. In this sense, social interaction and collaborative learning play an important role in multidisciplinary group student-centered learning environment.

Although the interdisciplinary PBL was designed to foster students' collaborative and active learning skills, we know little about the process of working together amongst students from different disciplines during the tutorial. In this regard,

Leung (2002) emphasized the importance of obtaining a better understanding of the complex processes of students' participation in the context of student-centered learning. Hak and Maguire (2000) also pointed out that evidence from ethnographic and discourse research approaches are efficient and rational to exploring inside the PBL process.

A small body of qualitative and discourse research on student learning in PBL identified the emergence of students' co-constructed knowledge and their highly interactive dynamics in tutorial groups (for example, Hmelo-Silver and Barrows, 2008; Koschmann et al., 1997; Visschers-Pleijers et al., 2006; Woodward-Kron and Remedios, 2007). For instance, Visschers-Pleijers et al. (2006) found that in a PBL setting collaborative knowledge construction among students occurred more frequently than any one student's elaboration of knowledge. On the other hand, other studies noted several pedagogical issues of learners' participation in PBL, in particular, in non-Western cultural settings (Imafuku, 2012; Khoo, 2003; Legg, 2005; Remedios, Clarke, and Hawthorne, 2008). Khoo (2003) pointed out that the successful application of the PBL methods in Asian schools was impeded

due to different cultural practices, such as students' strong consciousness of assessment during their performance and lack of confidence in sharing their opinions. With regard to Japanese communication, Midooka (1990) mentioned that Japanese appropriate behavior is shaped by contextual factors, including the place, the relative status of members, one's relationship to those people, and their personality. That is, the contextual factors would affect Japanese students' participation in the PBL tutorial. The previous studies suggest that students' learning in PBL is a complex phenomenon, and its effectiveness varies according to the cultural context.

Therefore, we aimed to examine the process of undergraduate students' collaborative learning in interdisciplinary PBL tutorials at a Japanese medical university. In order to achieve the aim of this study, we developed the following research questions:

1. How do Japanese students participate in collaborative learning activities by working in a team with both members from the same and different disciplines in PBL tutorials?
2. What are the perceptions of students on learning in the interdisciplinary PBL tutorials, and how do their perceptions relate to their participation?

This study closely explored the processes of making a problem map in tutorial session 1 and sharing the results of self-directed learning in tutorial session 2.

## Context of the Study

The context of the study is a Japanese university (Showa University) that comprises four schools:

1. Medicine (M)
2. Dentistry (D)
3. Pharmaceutical sciences (P)
4. Nursing (N), Occupational therapy (O), and Physiotherapy (PT)

In the third-year (M, D, and P) and second-year (N, O, and PT) undergraduate curriculum, each school has a course of basic patient-centered care. A pedagogical approach of interdisciplinary PBL has been incorporated into the undergraduate curriculum since 2009. The objectives of the course are to acquire the skill to share and communicate the patient's information with different professionals as a member of medical team and the skill to present an appropriate treatment and care plan to address the patient's social, psychological and economical condition.

In relation to the PBL process, tutorial session 1 (T1), which lasted 90 minutes, started by presenting a group of students with the problems of clinical scenario. Through the group discussions and using prior and current knowledge of the content of the scenario, students identified learning is-

ues. They then independently researched the learning issues outside the classroom (Self-Directed Learning). One week was allotted to the period of self-directed learning. In tutorial session 2 (T2), which also lasted 90 minutes, they regrouped to share the results of self-directed learning and make a care plan for the patient.

The theme of the scenario was rheumatoid arthritis which carried across both tutorial sessions of the three groups in this study. The patient in this scenario gave consent to sharing the examination results of rheumatoid arthritis for the purpose of education and research. Figure 1 on the next page shows the details of the interdisciplinary PBL process in T1 with the clinical scenarios and task materials, such as video data of medical interview, and images of X-ray, condition of tongue and articulation. In steps 1–3, students discussed the patient's problems based on the information presented in the scenarios and shared their prior knowledge with other professional students. In step 4, students worked on a problem by making a problem map that visualized the relationships between keywords selected from the scenario. In step 5, they identified knowledge gaps and set learning issues.

In the self-directed learning step (step 6), students needed to study the learning issues related to both their areas of expertise and non-expertise. For example, a nursing student studied ways of taking care of an articular rheumatism patient (expertise) as well as oral care and treatment for the patient (non-expertise).

Figure 2 below shows the scenario and PBL process in T2, which lasted about 90 minutes. Students shared the results of individual study until all objectives had been covered (step 7). After each presentation, they had question-and-answer time to better understand the problems. The members then read Scenario 2 and made a care plan for the patient to prepare for the group presentation (step 8).

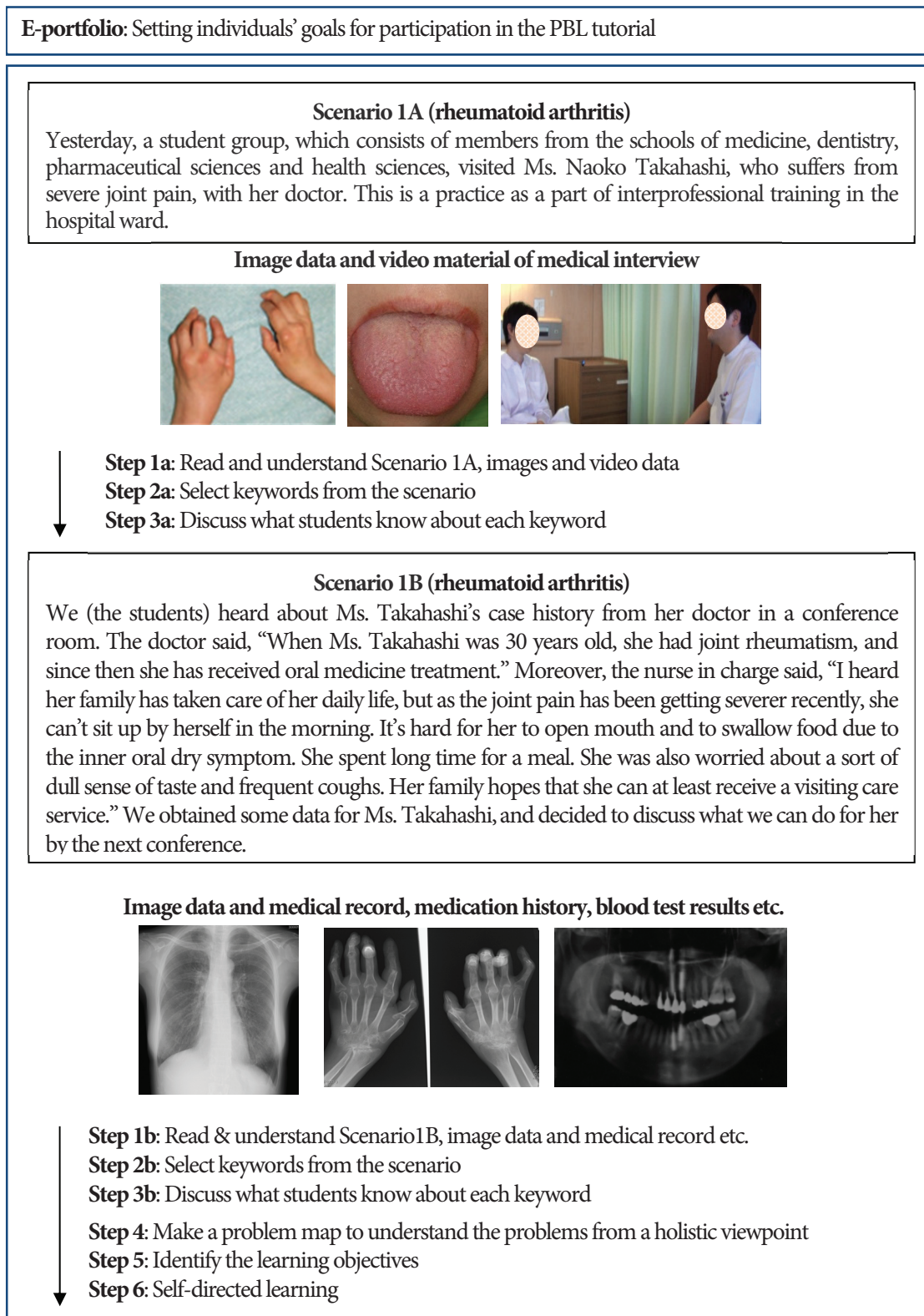
Furthermore, an electronic portfolio (e-portfolio) was used to enhance students' reflective learning skills. As shown in Figures 1 and 2, students needed to submit their individual goals for PBL participation before T1 and to report their reflection on learning experiences and their aspiration for the future study after T2.

## Research Design

### Research Participants

Before data collection, the authors explained the purposes of this research to the students. Consequently, there were five groups in which all members gave consent to video-recording of the tutorials out of 36 groups. We then randomly selected three of these five groups. Table 1 provides details on the participants, including students and tutors. There were eight to nine members per group. Third-year undergraduate students

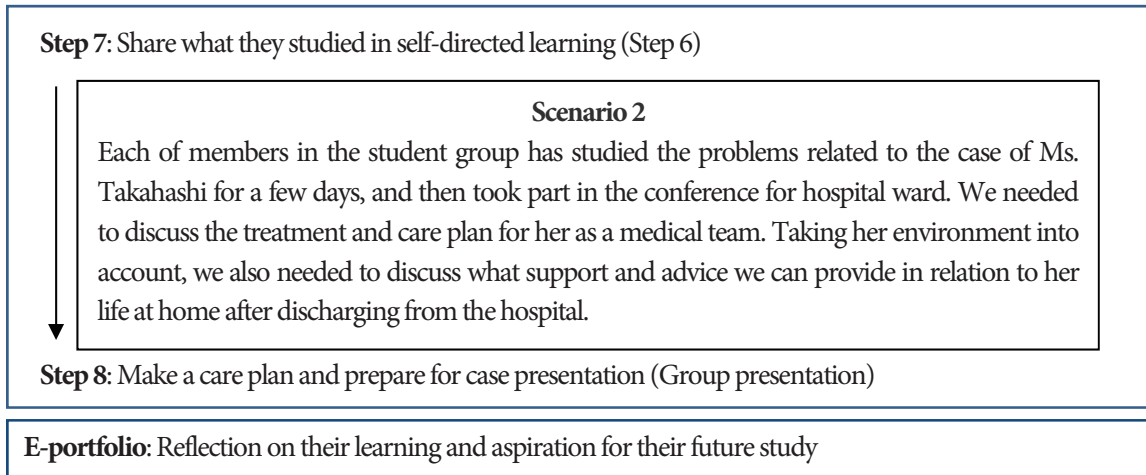
Figure 1. The PBL process (Tutorial session 1)



were from the Schools of Medicine, Dentistry, and Pharmaceutical Sciences, and second-year students from Schools of Nursing, Occupational Therapy, and Physiotherapy.

As a pedagogical approach of PBL has been used in undergraduate education at Showa University, the students have experience in learning collaboratively in a PBL setting. However,

Figure 2. The PBL process (Tutorial session 2)



it was the first time they shared their expertise with members from different disciplines. Before the interdisciplinary PBL, they had an two-hour induction class to explain the tutorial process and the importance of working with members from different disciplines. The tutors in three groups had more than five years' experience as PBL facilitators.

**Qualitative Research Framework**

*Ethnography*

Various social researches on education, communication and anthropology have pointed out that ethnography is an effective strategy for better understanding the complexities of participants' activities and discourse in a cultural context. Ethnography is defined as the "science of cultural description" in that a hallmark of this approach lies in an in-depth description and understanding of cultural patterns within the

particular contexts (Wolcott, 2008). The emphasis of ethnography is on closely looking at culture, which can be "shared patterns of beliefs, normative expectations and behaviours, and meanings" (McMillan, 2008, 276). In qualitative educational research that was underpinned by the ethnographic framework, classroom and educational events were regarded as socially-organized environments in which the culture is shared amongst the participants. We thus identified a PBL group as a culturally organized community.

*Case Study Approach*

Case study approach has a similar philosophy to ethnography for investigating phenomena in contexts. Yin (1989, p. 23) defines a case study as "an empirical inquiry that investigates a contemporary phenomenon within its real life context; when the boundaries between phenomenon and context are not clearly evident; and in which multiple

Table 1. Research participants.

Group 1			Group 2			Group 3		
Name	Gender	Faculty	Name	Gender	Faculty	Name	Gender	Faculty
M1	Female	Medicine	M3	Female	Medicine	M5	Male	Medicine
M2	Male	Medicine	M4	Male	Medicine	M6	Female	Medicine
D1	Male	Dentistry	D2	Female	Dentistry	D3	Male	Dentistry
P1	Male	Pharm. sc.	P4	Male	Pharm. sc.	P7	Female	Pharm. Sc.
P2	Female	Pharm. sc.	P5	Female	Pharm. sc.	P8	Male	Pharm. Sc.
P3	Female	Pharm. sc.	P6	Female	Pharm. sc.	P9	Female	Pharm. Sc.
O1	Female	Occupational Therapy	N3	Female	Nursing	O2	Female	Occupational Therapy
N1	Female	Nursing	N4	Female	Nursing	N5	Female	Nursing
N2	Female	Nursing	PT	Male	Physiotherapy			
T1	Male	Medicine	T2	Male	Pharm. sc.	T3	Male	Medicine

Table 2. Key speech functions in the PBL tutorial.

Move	Speech function	Description	Example (text was translated by the authors)
Initiation (re-initiation)	Question (Elicitation)	Utterance to elicit an obligatory verbal response or its non-verbal surrogate.	What kind of disease is Sjögren syndrome?
	Informative	Utterance to provide information, report event, recount personal experience, or express beliefs, feelings and thoughts.	I thought what I studied was a bit different from your idea about an alternative plan of giving drugs...
	Ask for clarification	Get additional information needed to understand prior move	Do you know how to make differential diagnosis of pneumonia?
	Ask for confirmation	Confirm the speaker's assumption & verify information heard	Do you mean Sjögren syndrome causes renal failure?
	Develop	Expand on a previous speaker's contribution by adding further details	I want to add one more thing. Sjögren syndrome obstructs the secretion of saliva. Due to this, some decayed teeth easily develop in her mouth.
Response	Answer	Provide information demanded in question, and indicate acceptance of speaker's report as a true representation of events	Sjögren syndrome is a sort of autoimmune disease...
	Agree	Indicate support of information given	Yeah. I agree. I think so.
	Clarify	Give clarification demanded by 'asking for clarification' move	Some books said that if patient has interstitial pneumonia, we can see this fibrous stuff in her lung on the roentgenogram
	Confirm	Give clarification demanded by 'asking for confirmation' move	When you see renal failure, you have to be careful of the possibility of Sjögren syndrome.
	Challenge	Queries or refuses to accept a factual account of events or states of affairs given by the speaker. Provide negative response to the speaker's evaluative opinion.	We need to think about QOL separately. I don't understand the relationship between QOL and anemia on the white-board.
Follow-up	Acknowledge	Indicate knowledge of information given	Oh. Yes. I see.

sources of evidence are used." Hence, the research scope should be narrowed down to a context so as to make an in-depth analysis of the complex phenomenon (Merriam, 1988). Since the focus of this study is on better understanding the interactions between students from different disciplines and their reflection on learning experiences, the intention of case study approach is entirely consistent with the objectives of this study.

#### *Classroom Discourse Analysis*

Discourse and culture are important analytical aspects of students' participation in PBL tutorial. Bridges, Whitehill, and McGrath (2012) highlighted that analysis of discourse data would provide deeper insights into the PBL process. As a means of examining the students' problem-solving processes, we adopted the notion of Initiation-Response-Follow-up (IRF) sequence and speech functions (Eggin and Slade, 1997).

In relation to discourse structure, Sinclair and Coulthard (1975) found that a basic form of exchange in classroom situation consists of IRF components. That is, the teacher asks a question, the student responds, and the teacher then gives feedback. Although IRF model originally describes the structure of teacher-led discourse, it could provide a framework to describe student-centered PBL discourse. In particular, Tsui (1994) argues that the third component of an exchange is essential to not only classroom discourse but also daily conversation in that it functions as acknowledgement of the outcome of the interaction. That is, this notion of three-part exchange can be applied to the analysis of discourse structure in the context of student-centered PBL. In addition, Eggin and Slade (1997) provided a detailed analysis of casual conversations by employing 45 subclasses of speech functions. We applied the IRF model and the typology of speech functions to the context of PBL, and identified key speech functions. The essence of analytical framework is provided in Table 2.

An initiation move functions to start a talk through the introduction of a new proposition. In this study, five subclasses of initiation moves (i.e., question, informative, ask for clarification/confirmation and develop) were used as key speech functions. A responding move is achieved by another speaker taking the floor, such as to answer and agree. A follow-up move has the general function of acknowledging the outcome of an exchange (Tsui, 1994). Acknowledgement is a follow-up move to indicate members' understanding of the prior exchange and attitude of active listening, which creates a supportive group climate (Imafuku, 2013). Therefore, in this study, acknowledgement is an important speech function in the tutorial.

**Data Collection Procedures**

*Video-recordings of PBL Sessions*

Three PBL groups were video-recorded to analyze their actual engagement in the discussions. The duration of recording of each session was approximately 1.5 hours. The recorders were set in the corner of the room in order to minimize any disruption to participants' interaction and behavior. In order to record their conversations as clearly as possible, external wireless microphones were adhered to the wall beside the table. We selected the segments of students' discussions on problem mapping (step 4) in T1 and sharing the results of their self-directed learning (step 7) in T2, because sharing knowledge with students from different disciplines in these steps is essential to solving the problems. Conversational data of the tutorial sessions were transcribed and translated into English by the first author. Then, each utterance made by the participants was given a label of speech functions.

*Collection and Analysis of E-portfolio*

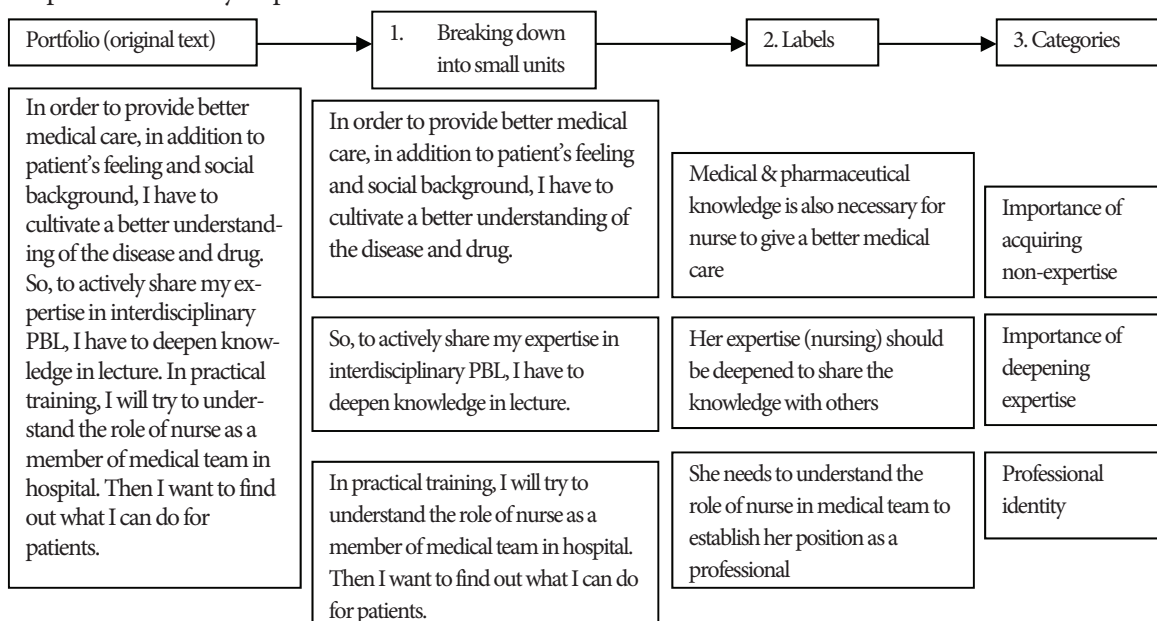
In order to analyze students' introspection, the reflective reports on their learning experiences were retrieved from the web-based system of the e-portfolio. Japanese text data were translated into English by the first author and qualitatively analyzed by coding and categorizing (Strauss and Corbin, 1998). Texts from the portfolio were carefully reviewed multiple times to inductively generate salient categories related to students' participation. Conceptualizing was the first step of the analytical process to identify the concepts representing issues and concerns that emerged from the texts. An example of data analysis process is provided in Figure 3 below.

Figure 3 reviews a nursing student's reflection report in portfolio. First, text data were divided into small units according to the meanings, actions, events or ideas (three units in Figure 3). Second, each of these small units was labeled with an interpretive description. Last, the labels were categorized into more abstract conceptual groups, such as importance of professional identity, obtaining expertise, and non-expertise. At this stage, peer debriefing was used as a technique to establish credibility and validity of the data analysis. That is, the authors worked together on the coding of the data to prevent some critical problems of analysis, such as misinterpretation of data, vague descriptions of coding, and biases made by an author.

**Findings**

The first purpose of this study was to examine how students from different disciplines work together and make a care plan

Figure 3. Example of data analysis process



for the patient in the PBL tutorial. We found that two main interaction patterns of knowledge construction emerged from three PBL groups: 1) co-construction of knowledge between students from different disciplines; and 2) elaboration of knowledge between students from the same discipline. Specifically, in this section, we will demonstrate how these different patterns of group interaction emerged by exploring the processes of making a problem map in T1 (step 4) and sharing the results of self-directed learning in T2 (step 7).

### Making a Problem Map in Tutorial Session 1

We examined how collective knowledge was constructed through interaction between the students from different disciplines in the PBL tutorial. First, the students' interactions in T1 (step 4) were examined. A problem mapping is a graphical tool to promote an understanding of the problems by organizing and relating keywords selected from the scenario. The students needed to work on making a problem map to illustrate the problems in the scenario in step 4 (see Figure 1). Actively sharing opinions with different professional students is pivotal to making a comprehensive problem map of the articular rheumatism patient.

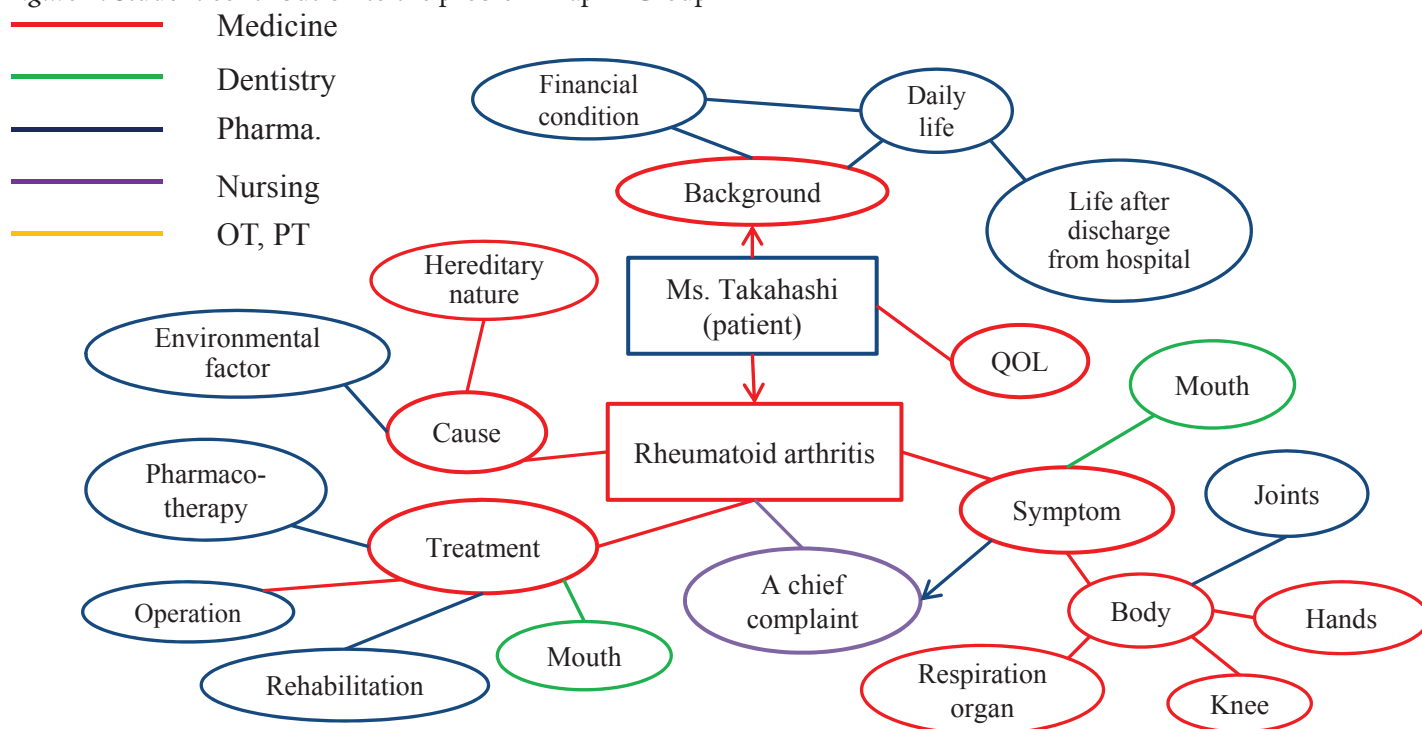
In Figure 4, different colors of circles, arrows, and lines symbolize the school of a student who made contribution to the problem map. Medical and pharmaceutical students in Group 1 were considered the dominant members in the discussions, and other members' opinions appeared not to be sufficiently reflected in the mind map. In particular, as Figure 4

shows, an occupational therapy (O) student did not make any contributions to the discussion.

Furthermore, although the patient was positioned at the center of the map, Group 1 tended to focus much more on knowledge of rheumatoid arthritis during the discussion. Figure 4 shows rheumatoid arthritis has four sub-concepts, such as a chief complaint, causes, treatment, and symptoms. On the other hand, the patient in Figure 4 is only connected to quality of life (QOL) and her background. In particular, QOL does not have any sub-concept. That is, Figure 4 shows that Group 1 did not deeply discuss the problems related to the patients and the relationships between her QOL and medical care of rheumatoid arthritis. Excerpt 1 on the next page below provides Group 1's discussion of making the problem map.

In Move 1, D1 suggested that the members focused only on their expertise to efficiently make the problem map, and then M1 agreed with D1. From Move 3 to Move 12, four particular members (M1, M2, P1 and P2) predominantly made contributions to the discussions. These four members' opinions directly influenced the mind map in Group 1, and other members rarely made responding or follow-up moves in the discussions. For instance, in Move 7, P1 shared an opinion that pharmacotherapy, rehabilitation and operation can be connected to treatment. However, other members did not respond to P1. In particular, O1 and N2 did not make any contributions to the discussion. This implies that consensus-building and in-depth analysis of key concepts were not made adequately between members from different disciplines in Group 1.

Figure 4. Student contribution to the problem map in Group 1





*Excerpt 1. Processes of making the problem map in Group 1*

No.	Japanese	English translated by the first author	Types of move*
1	D1 なんか領域ごとにやったらいんじゃない？学部ごとで。最初に関節リウマチっておいて、そっから口の人、薬の人、看護の人で	How about separately working on the mind map? According to each specialty, hmm, I think rheumatoid arthritis is the core theme. Then, dental students add something related to mouth, the pharmaceutical student thinks about medication, and nursing thinks about care service.	I: Informative
2	M1 そのほうがスムーズにできそうな気がする。それでやってきますか	Yeah, I think we can efficiently make the map in this way.	Res: Agree
3	P2 まずは大きなところから	Firstly, what is the core theme?	I: Elicitation
4	M2 真ん中に関節リウマチってどんって書いちゃえば	I think we can write rheumatoid arthritis at the center of the whiteboard.	Res: Answer
5	M1 まとめてかいちゃえば、症状と治療と	We can relate symptom and treatment all together [to rheumatoid arthritis].	I: Informative
6	N1 自分が言ってる、主訴みたいな	I think a chief complaint connects [to the theme].	I: Informative
7	P1 あの、治療のところに薬物治療とか、リハビリとか、手術とか	I think we can put pharmacotherapy, rehabilitation, and operation in treatment.	I: Informative
8	P2 症状と主訴ってつながらないかな	Symptom and a chief complaint can be related together.	I: Informative
9	M2 治療ってなにやるの？	What is treatment [for rheumatoid arthritis]?	I: Elicitation
10	M1 リウマチって手術するのかな	Is operation necessary for rheumatoid arthritis?	I: Elicitation
11	M2 なんか関節とかはずれちゃってとか	I think when the joint dislocated [it will be needed].	Res: Answer
12	M1 あーたしかに。じゃあそこには手術がいるね	Oh, I see. So, we need "operation" on our map.	F: Acknowledge

\*I-Initiation, Res-Response, F-Follow-up move

On the other hand, the members in Groups 2 and 3 tried to clarify the relationships between the patient and medical care by sharing their opinions with the different professionals. In Figure 5 each Group 3 student's professional school in Group 3 is represented by different colors. (See Appendix for Group 2's problem map.) Opinions from members from different disciplines were reflected to the mind map. In particular, dentistry, occupational therapy, and nursing students were more actively involved in the discussions than had been in Group 1.

The members in Group 3 tried to illustrate the complex relationships between rheumatoid arthritis and the patient's QOL. Figure 5 shows that rheumatoid arthritis and QOL are connected to all key concepts. Excerpt 2 depicts an instance of the process of making the problem map in Group 3.

In Move 1, M5 mentioned that rheumatoid arthritis can be analyzed separately from QOL. However, in Move 2, D3 made a challenging move to give another perspective that QOL can be connected with all key concepts. D3's contribution prompted members' participation and made them focus on the problems of their patient rather than rheumatoid arthritis itself. As a result, QOL was connected to "joint pain" and "housework" by M5 (Move 3), "pharmacotherapy" by P8 (Move 5) and "the oral cavity" by M6 (Move 12). Moreover, in Move 13, D3 confirmed that all key concepts were related to QOL, and he shared his opinion that the medical care was conducted to secure and improve the patient's QOL. D3's opinion was acknowledged by all members in Move 14. Therefore, Excerpt 2 demonstrates that the members in Group 3 could more clearly realize the importance of patient-centered medicine through discussion with students from different disciplines.

Excerpt 2. Processes of making the problem map in Group 3

No.	Japanese	English translated by the first author	Types of move*
1	M5 とりあえずQOL以外を関節リウマチと結びつけて	First of all, we can relate rheumatoid arthritis to all groups except "QOL."	I: Informative
2	D3 でも全部QOLに結びつきそう、ははは	But, it seems all can connect to QOL, hahaha.	Res: Challenge
3	M5 ひざ、関節痛とかによって、あのう、家事が困難みたいなかんじで、なんかQOLに。あと、起き上がれないとかもそうだね	"Knee and joint pain," hmm, seem to cause difficulty in housework. So, they can be related to QOL. And, also "difficulty in sitting up in the morning."	I: Informative
4	O2 QOLにつないじゃっていい	I agree that both of them can connect to QOL.	Res: Agree
5	P8 薬物療法とQOLもつながらない？	I think, pharmacotherapy also relates to QOL, doesn't it?	I: Informative
6	P9 うん	Yeah . . .	Res: Agree
7	副作用とかもあるから	. . . it includes side effects	RI: Develop
8	D3 全部QOLにつなげちゃっていい	I think, eventually all can be related to QOL.	I: Informative
9	N5 うん、うん。たしかに全部つながるかもしれない	Yes, yes, all may connect to it.	Res: Agree
10	M5 うん	Yeah.	Res: Agree
11	P8 うん	Yeah.	Res: Agree
12	M6 あと、口とかも、しゃべりづらかったら...	In addition, I think oral cavity also [relates to QOL]. If the patient has difficulty in speaking . . .	RI: Develop
13	D3 QOLを守るためのものだもん	All are for securing and improving the patient's QOL.	RI: Develop
14	All うん	Yeah.	F: Acknowledge

\*I-Initiation, Res-Response, F-Follow-up move

Figure 5. Students' contribution to the problem map in Group 3

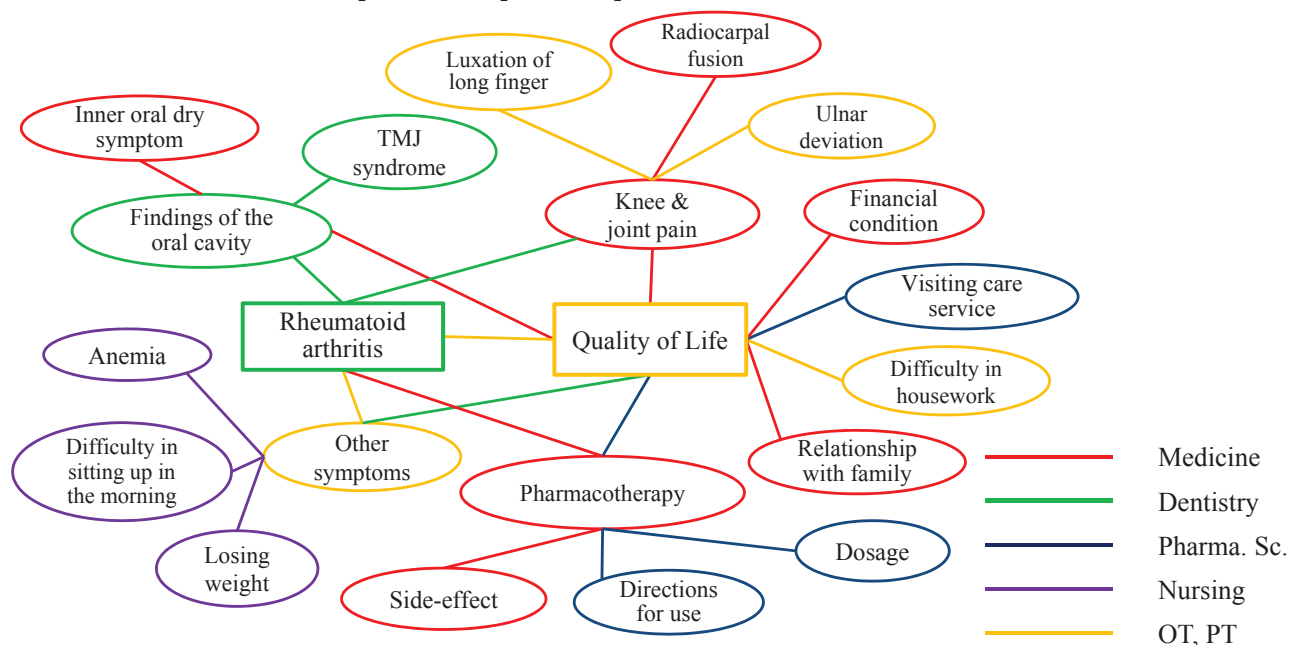


Table 3. Actual number of moves made by the students.

	Group 1										Group 2										Group 3								
	M1	M2	D1	P1	P2	P3	N1	N2	O1	To- tal	M3	M4	D2	P4	P5	P6	N3	N4	PT	To- tal	M5	M6	D3	P7	P8	P9	N5	O2	To- tal
Question to member from different disciplines	0	1	0	1	0	0	0	0	0	2	0	1	0	2	1	2	0	0	0	6	1	0	2	2	1	0	0	0	6
Question to member from same discipline	0	1	0	0	1	1	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Answer/Develop	2	6	0	0	2	5	0	4	0	19	3	13	1	3	7	1	3	0	2	33	4	9	3	3	5	0	2	8	34
Ask for confirmation/clarification	0	3	0	2	1	0	0	0	0	6	0	1	1	2	0	6	0	0	0	10	2	0	10	0	3	0	0	0	15
Agree/acknowledge	4	2	0	4	2	1	0	0	0	13	0	5	1	3	2	5	0	0	0	16	1	4	9	0	2	2	0	5	23
Total	6	13	0	7	6	7	0	4	0	43	3	20	3	10	10	14	3	0	2	65	8	13	24	5	11	2	2	13	78

### Sharing the Results of Students' Self-directed Learning in Tutorial 2

In addition to students' learning in T1, we explored the process of students' sharing what they studied (step 7) in T2. Based on the framework of classroom discourse (see Table 2), we categorized students' reciprocal utterances made in step 7 into five main groups:

- question (to members from different disciplines)
- question (to members from the same discipline)
- answer or develop
- ask for confirmation or clarification
- agree or acknowledge.

Table 3, which provides the statistical data of their verbal participation, indicates that the students in Groups 2 and 3 more frequently performed (1) question between the different professional students, (2) develop, and (3) ask for clarification. On the other hand, students in Group 1 tended to do (1) question and answer between the same professional students.

In order to visualize the state of their group dynamics, Figure 6 was generated to indicate each student's frequency of verbal participation and member-to-member interaction. The size of the circles in Figure 6 represents the number of utterances by each member and the thickness of the lines displays the frequency of member-to-member verbal interaction. The different types of speech functions are symbolized with different colors and patterns of the line (Lee and Lee, 2009).

Figure 6 shows relatively poorer interaction between the students in Group 1 than other groups. Only M2 made contributions to the discussion actively, whereas D1, N1, and O1 did not make any contributions to the discussions in the tutorial. Moreover, in Group 1, interactions between the same professional students, such as between M1 and M2 and between P2 and P3 (see red lines in Figure 6) occurred more commonly than discussions between students from different disciplines. Thus, only certain members were involved in step 7 of the tutorial, and they tended to elaborate each solution between students from the same discipline rather than sharing clinical information and collaboratively producing the care plan with others.

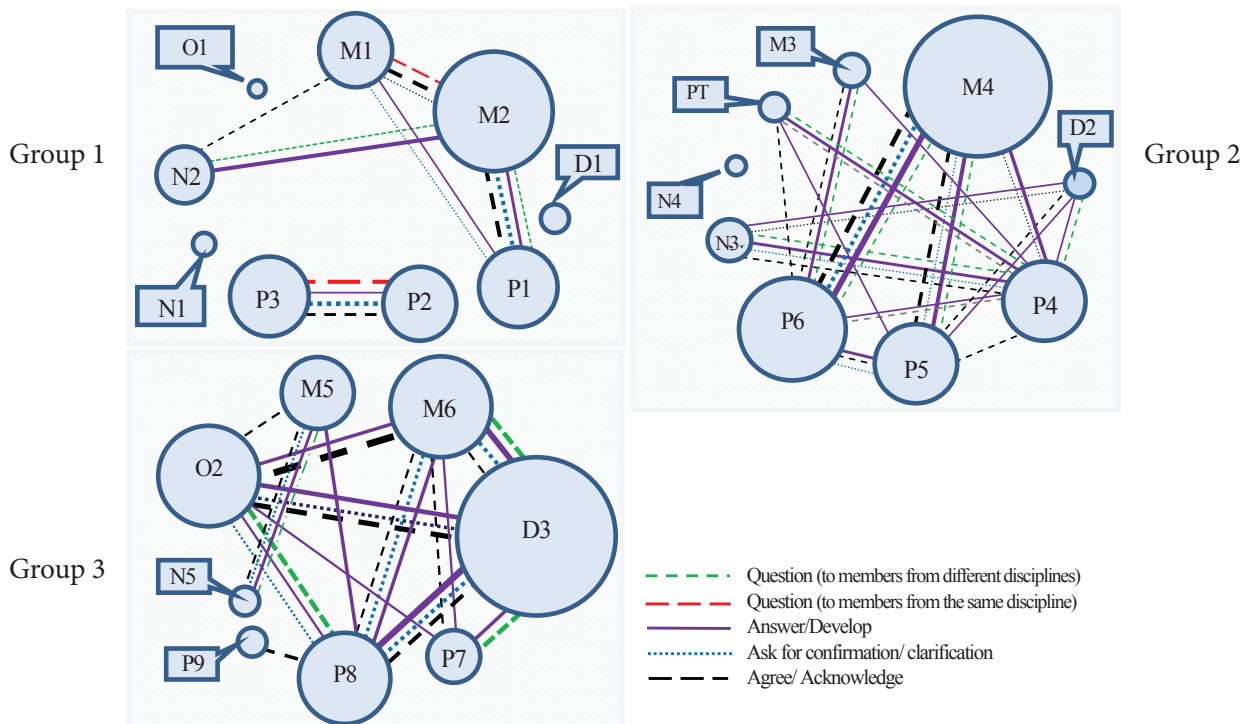
Excerpt 3 gives an example that an alternative plan of giving drugs for the patient was discussed only between two pharmaceutical students in Group 1. In Move 4, P2 asked P3 about the pharmaceutical features of leflunomide. Responding to P2's question, P3 shared factual information that it is an anti-rheumatic drug which can be used instead of Methotrexate. Moreover, in Move 6, P2 asked for clarification to P3 about a way of giving leflunomide to a rheumatic patient. However, P3 also did not know the way of administration in Move 7. Thus, P2 and P3 could identify

Excerpt 3. Elaboration between students from the same discipline in Group 1

No.	Japanese	English translated by the first author	Types of Move
1	P3 なんか若干ちがったよね、代替案 ((P2と))と って。	I thought what I studied was a little bit different from your presentation about an alternative plan of the medication.	I: Informative
2	P2 うん。たしかに	Yeah, that's right.	Res: Agree
3	P3 なんかその違いは私はシェーングレンをからめて 考えるのを忘れてしまっていて	The difference might come from the fact that I forgot to take Sjögren syndrome into account.	Continue
4	P2 それはわたしも考えるのを忘れてたけど、メト トレキサートからレフルノミドって、レフルノミド ってどういう系統の薬でしたっけ?	I also forgot it. I related Methotrexate to leflunomide. Which line of medicine is leflunomide?	I: Question
5	P3 えっと種類、系統は一緒に ((資料参照)) えっと ね。抗リウマチ薬ってやつだ。疾患修飾性抗リウ マチ薬のなかに入ってるやつで、一応推奨度はA で、メトトレキサートが効かなくなった場合の代 替薬としては挙げられているかんじかな	Hmm, it is the same kind, line as Methotrexate [referring to resources]. Hmm, it is an antirheumatic drug, which is categorized into disease modifying antirheumatic drugs. The level of recommendation is 'A.' So, when Methotrexate does not work, it can be used as an alternative medication.	Res: Answer
6	P2 たぶんおなじのを参考資料で使ってると思うん だけど、これはどうなんだろう。生物学的製剤の併 用っていうのは考えられるのか、これ単独で使う のか、それとも生物学的製剤を併用するのか、そ れともあっちを単独で使うのかっていうのが	Probably, we used the same resource for this learning objective. Hmm, Biological drug. Can it [leflunomide] be used with biological drug? Or should it be used separately from others?	RI: Ask for clarification
7	P3 そうだね。よくわからないね。	Yeah, I don't know, either.	Res: Withhold
8	P2 だからこれも調べた方がよさそう。	So, we need to study more about it.	F: Acknowledge

\*I-Initiation, Res-Response, F-Follow-up move

Figure 6. Each member's verbal participation and group dynamics in T2



*Excerpt 4. Co-construction between students from different disciplines in Group 3*

No.	Japanese	English translated by the first author	Type of move
1	D3 この患者さんは、肺炎っていうのは確定？	Can we confirm that this patient has pneumonia?	I: Question
2	M6 確定とは言えない、言えなくはないんだけど。要するに、なんだっけなあ。さっきの薬。((資料を探す))	We can't say it definitely, hmm, it may be. That is, what's the name of medicine we discussed just before?	Res: Answer
3	O2 薬によって、たぶん間質性肺炎が	Medicine used for the patient, probably, was related to the symptom of interstitial pneumonia.	RI: Develop
4	M6 そうそう	Yes, yes.	Res: Agree
5	薬剤による間質性肺炎を起こしている可能性がある	There is some possibility that medicine causes interstitial pneumonia.	Continue
6	O2 ((うなづく)) 可能性がある	[nodding] Yes, there's a possibility.	F: Acknowledge
7	P8 可能性があるの？	Is there a possibility [of interstitial pneumonia]?	RI: Ask for clarification
8	M6 可能性が高いね。だって使ってる薬がなんていったっけ。((資料参照))	It's high possibility, because, hmm, what's the name of medicine we just discussed?	Res: clarify
9	P8 肺炎とは書いてないの？	Doesn't the scenario say 'pneumonia'?	RI: Ask for clarification
10	D3 肺炎ってどうやって確定するの？	How do we confirm if the patient has got pneumonia?	RI: Ask for clarification
11	O2 なんかこの、繊維状のものが肺の中にあらわれるのが間質性肺炎みたいなかんじのことを、書いてあって	Hmm, some books said that if patient has interstitial pneumonia, we can see this fibrous stuff in her lung on the roentgenogram.	Res: Clarify ((continued to 13))
12	M6 ((うなづく))	[nodding]	Res: Agree
13	O2 今回それがこのX線のなかにもみれるので	This time, I can see the fibrous stuff on this roentgenogram	((Response: Clarify))
14	D3 あ [全体的にこれが	Oh, overall, this is . . .	F: Acknowledge
15	M6 うん [全体的にこれが真っ白になってるのが	Yes, this turned white overall.	RI: Develop
16	O2 白いのが繊維状になってる。 [ほんとは写らないはず。]	We can see white fiber stuff. If the patient had no problem, it would not appear on it.	RI: Develop
17	D3 [はい、わかりました	OK, I get it.	F: Acknowledge
18	じゃあ、これが間質性肺炎で薬剤性じゃないかってこと？	So, you mean this interstitial pneumonia is drug-induced?	RI: Ask for confirmation
19	O2 はい	Yes, I do.	Res: Confirm
20	D3 はい、わかりました。	OK	F: Acknowledge

\*I-Initiation, Res-Response, F-Follow-up move

their knowledge gap with regard to leflunomide. In Excerpt 3, the pharmaceutical students elaborated on a way of giving appropriate drugs to the rheumatic patient. However, the content discussed between them was not shared sufficiently with others who were outside the field of pharmaceutical sciences. As a result, the members had no option but to remain quiet during “the specialist talk.”

As compared with Group 1, Figure 6 shows that students in Groups 2 and 3 could more collaboratively discuss with their members. However, the difference between the active

participants (M4, P4, P5, and P6) and the others (M3, D2, N3, N4, and PT) was larger in Group 2. In particular, N4 remained quiet and was isolated from others. On the other hand, although three members were seen as relatively quiet participants, more than half of the students in Group 3 could make contributions actively to the discussions. Furthermore, interactions among different professionals occurred more frequently in Group 3. Excerpt 4 provides an example of the discussions on the diagnosis of pneumonia between the different professionals in Group 3. In Move 1,

D3 asked about the deferential diagnosis of pneumonia in the case of rheumatic patient. Responding to D3's initiation move, in Moves 2 through 6, M6 and O2 pointed out the possibility of interstitial pneumonia caused by drug use. In Moves 9 and 10, P8 and D3 tried to further seek for evidence of the possibility of pneumonia. O2 and M6 collaboratively answered members' inquiries by mentioning the presentation of white "fibrous stuff in her lungs on the roentgenogram" (Moves 11 to 16). At the end of Excerpt 4, the members in Group 3 could reach a shared understanding of the rheumatic patient who has great possibility of the drug-induced interstitial pneumonia.

In Group 3, more members appeared to be interested in the learning objectives related to their non-expertise in addition to their expertise. For instance, although a learning objective was about the diagnosis of pneumonia, dentistry, pharmaceutical, and occupational therapy students were actively involved in the discussion. Consequently, they could conclude that the rheumatic patient has the possibility of drug-induced pneumonia based on information from the roentgenogram. Therefore, more members in Group 3 were able to actively participate in the discussions and share information necessary to interdisciplinary approach to health care.

## Discussion

We examined the students' reflection, responses to and perceptions of their experiences in the interdisciplinary PBL. From the data analysis of students' e-portfolios, several social and cultural factors affecting the group interactions emerged. In this section, students' perceptions of the learning environment, difficulties encountered in PBL, and professional identity are discussed.

### Perceptions of Learning Environment and Social Relationships

Students' understanding of other professionals, perceptions of collaborative learning, and interpersonal relationships in the PBL group positively affected their participation in Groups 2 and 3's tutorials. For instance, in their e-portfolios, compared with students in Group 1, more students felt that working with the different professional members provided a new perspective for the patient care. Medical and pharmaceutical students have tended to only focus on knowledge of disease itself. However, as Excerpts 5 and 6 show, through interacting with nursing and occupational therapy students, they realized the importance of taking the patient's social and emotional conditions into account when they made a care plan, and the medical and pharmaceutical students shared information between the different professional members.

#### Excerpt 5

P6: Through interaction with nursing and occupational therapy students, I could make a more practical care plan which took the patient's feelings and life into account. Moreover, I think this PBL gave me really valuable experience in that I could be aware of the importance of understanding the problems of the patient from a broader point of view. (Group 2)

#### Excerpt 6

M5: In PBL which I experienced in the School of Medicine, I've focused only on an appropriate diagnosis and treatment. This time, the scenario describes the patient's situation in detail, and by knowing viewpoints of nursing and physiotherapy students, I could examine the best care plan for the patient in the line with her circumstance. . . . This experience allows me to understand the importance of an interdisciplinary approach to health care and sharing knowledge among the different professionals. (Group 3)

Furthermore, as shown in Excerpt 7, M4 became aware that an attentive listening attitude, including acceptance of and respect for members' different opinions, was essential in group work to create a supportive group atmosphere and to make a comprehensive care plan for the patient.

#### Excerpt 7

M4: In this PBL, I realized the importance of accepting and understanding others' different opinions from mine. And such attentive listening will make a friendly group atmosphere. By doing so, when a member expresses an opposing opinion, it is possible to further analyze a topic from a new perspective. I think if we all take such a supportive attitude, we can propose a more comprehensive care plan which is suitable for a patient. (Group 2)

Many members in Groups 2 and 3 commented that it was important to acquire effective communication and collaborative working skills for patient-centered care.

### Difficulties Encountered in PBL Participation

Students in Group 1 expressed difficulties and points for improvement of their participation more than positive perceptions of their learning experiences in the interdisciplinary PBL. For example, Excerpt 8 indicates that P2 could not elucidate pharmaceutical terminology to other members, and she did not sufficiently share the discussion between the same professionals as with others. This reflection came from her experience of interactions with P1 in relation to leflunomide (see Excerpt 3).

*Excerpt 8*

P2: We could propose specific ways of treatment and drugs for the patient, but we have to improve clinical reasoning and sharing of information among all members. In particular, I was a member of pharmaceutical sciences who made a plan of drugs for the treatment of a rheumatic patient, but I couldn't give an explanation of drugs to others who are not pharmaceutical students. I should have shared the information, but it's hard for me to explain it intelligibly to others. (Group 1)

Moreover, M2, as expressed in Excerpt 9, felt it was difficult to adapt to the new learning environment in which students from the different disciplines work together in a group. Specifically, he could not actively make contributions to the discussions on the contents of other disciplines, and sometimes remained quiet. However, M2 was able to express his aspirations for future learning based on his experience with difficulties that he encountered in the PBL. That is, his attitude toward collaborative learning has changed through experience of learning in the PBL tutorial.

*Excerpt 9*

M2: As I got used to discussing a case of disease only among medical students, it is difficult for me to actively participate in the discussion of topics which are outside my field. I couldn't sweep away a sort of uncomfortable feeling of working with different professionals during the PBL. However, after the PBL, I realized the importance of active and collaborative participation to make a better care plan. (Group 1)

In addition to explaining expertise to the members, we found that sociocultural factors affected their participation. For instance, the students from schools of nursing, occupational therapy and Physical therapy felt it difficult to communicate with the senior students (that is, M, D, and P). Excerpts 10 and 11 show that N1 and N2 hesitated to share their opinions with the senior members.

*Excerpt 10*

N1: I tensed up and was somewhat reluctant to discuss with the senior members. I worried if my opinion would disturb the group discussion. That's why I sometimes became quiet on purpose, but I know this is not a good idea. (Group 1)

*Excerpt 11*

N2: I hesitated to ask about what I don't know and share what I thought with other members. I couldn't actively communicate with third-year members. I could just ex-

press my opinion when the senior members turn the floor over to me. (Group 1)

In general, the number of moves made by nursing, occupational therapy and physical therapy students was less than others (see Table 3). These students tended to be quiet and felt it difficult to actively participate in the discussion with the senior students. Furthermore, as Excerpt 10 indicates, some students prioritized collective learning activity over individual performance during the group discussion. That is, they sometimes refrained from commenting on purpose so as not to disturb the flow of discussion.

**Development of Professional Identity**

Professional identity involves ways of being and relating in professional contexts (Goldie, 2012). Interestingly, in addition to Groups 2 and 3, analysis of e-portfolio data indicates that students in Group 1 also appeared to develop their professional identity and realized the importance of an interdisciplinary approach to health care through participation in the PBL tutorial. For instance, Excerpt 12 shows that O1 emphasizes collaboration among team members with a strong sense of responsibility as an occupational therapist.

*Excerpt 12*

O1: In this PBL, I realized the importance of not separating medical professionals' responsibilities but collaboration among team members for patient care. I want to make a care plan which considers patient's life and background with a responsibility of an occupational therapist (Group 1)

Furthermore, as Excerpt 13 below shows, M2 could consider deeply what a doctor can do for the patient and learned that collaborative working skills with other health professionals were pivotal to giving comprehensive health care services.

*Excerpt 13*

M2: Through the PBL tutorial, I really felt that what a doctor can do for a patient is a tiny contribution. I have to think more about what I can do as a doctor in health care site, and I realize the importance of effective communication among other medical professionals to provide comprehensive health services (Group 1)

Therefore, although students' verbal interactions among members from different disciplines in Group 1 were relatively poorer than other groups, they could clarify their improvements as to their PBL participation through reflection on their experience of the discussions. Excerpts 12 and 13 indicate that through working and interacting with members from different professional backgrounds, their professional

identities were somewhat developed and their attitudes toward learning were changed.

## Conclusions

### Summary of the Findings

This is one of the first studies examining students' discursive practice and reflection on their learning in an interdisciplinary PBL in Japan. Although there were different interaction patterns among the three groups, such as co-construction between the different professionals and elaboration between the same professionals, this PBL provided the students with an opportunity to understand that effective communication and collaborative work between the different professionals is essential to the patient-centered care. According to the analysis of their e-portfolios, through active interactions between the different professionals, students in Groups 2 and 3 developed their professional identities. Although the students in Group 1 could not share the information related to their field sufficiently with others, their reflection on what they could not do in the PBL led to having their aspirations for future learning in group study and clinical clerkship. That is, their experiences of participation in this interdisciplinary PBL and reflective activity have affected their attitudes toward learning and formation of professional identities. The summary of the findings are provided as below:

- Elaboration on knowledge between students from the same discipline and co-constructions of knowledge between students from different disciplines emerged in three PBL groups.
- Some students felt it difficult to clearly explain expertise to the other members and communicate with the senior members.
- Group atmosphere, students' cultural assumptions, and supportive attitude toward different opinions affected their participation.
- Through the PBL, students realized the importance of patient-centered practice and interdisciplinary approaches to health care (in particular, effective communication among different professionals),
- Through working with others, students discovered different approaches to patient care; and
- Students better understood their health occupation and develop the professional identities.

### Implications for Practice of PBL

#### *Situated Participation*

With regard to Japanese communication, Midooka (1990) observes that one's appropriate behavior in a certain con-

text is shaped by contextual factors, including the place, the relative status of members, one's relationship to those people and their personality. In order to specify one's socially appropriate behavior in the group, the participant needs to obtain more situational information, including who is who, who is good at what, who knows what, and who is easy or hard to get along with (Wenger, 1998). The findings of this study support the view that the students' participation in the tutorials was situated in a context of PBL group. We found that group atmosphere, interpersonal relationships with members, and their cultural assumptions influenced their participation in the PBL tutorials. Many students in Group 1 felt it difficult to work collaboratively with members from different disciplines due to their cultural assumptions and situational factors. As Excerpt 10 shows, N1 tended to remain quiet and adjust her behavior to social expectation of the group. Her fear of making mistakes was not the major factor in her reticence. Rather, the importance she attached to the collective self was evidenced by her anxiety that her contribution might disrupt the group atmosphere and the flow of members' discussions. On the other hand, we also observed that members in Groups 2 and 3 actively shared their opinions to make a comprehensive care plan for the patient. For instance, M4 mentioned in Excerpt 7 that members' supportive attitudes toward others facilitated her participation and learning. Therefore, stereotyping Japanese students as reticent and dependent learners in a tutorial setting does not reflect the actual learning processes. Culture shapes the individual's interpretation of appropriate behavior in the social context of PBL tutorial (Imafuku, 2013). Tutors thus need to note that their participation is situated in a certain cultural context in order to facilitate students' learning.

#### *Listening to Learn and Learning to Listen*

Moreover, as recognized by M4 in Excerpt 7, listening to learn and learning to listen are important skills in the PBL tutorials. The participants perceived that active listening was closely linked with maintaining group harmony and making a supportive group atmosphere in a situation of interpersonal communication. Analysis of students' portfolio thus indicates that an active listening skill is necessary not only to obtain a better understanding of information given by speakers but also to create a supportive and respectful group atmosphere. That is, it has social as well as cognitive functions in interpersonal communication. To date, students' active self-expression and (co-)construction of knowledge through discussions have tended to be given more attention in the studies of students' engagement in PBL tutorials. There was a risk that learning through listening was regarded as verbal disengagement and less important behavior than making verbal contributions to the discussions (Remedios, Clarke, and



Hawthorne, 2008). Jin (2012) argues that silence is not only a verbal disengagement, but importantly also a collaborative practice and a platform of handling conflict (183). The findings indicate that active listening is one type of engagement that includes non-verbal behavior (such as nodding, eye contact, and facial expression) and verbal responses (such as agreement or acknowledge and asking for confirmation or clarification). As the students' introspection also indicates, active listening is central to interpersonal communication in a Japanese cultural context, and it is also essential to health professional-patient communication (Kurtz, Silverman, and Draper, 2005), or an interdisciplinary approach to medical care in which students will be involved in the future. Therefore, an understanding of different roles of silence is necessary for PBL facilitation. Both verbal contributions and active listening are the key skills for meaningful participation in the student-centred context of health professional education (Remedios, Clarke, and Hawthorne, 2008).

### Reflective Learning

Goldie (2012) stated that reflection is an important dynamic of personality change in terms of formation of professional identity. Reflecting on how they respond to new context can lead to change and to become a member in the community of practice (Lave and Wenger, 1991). In this regard, the e-portfolio played an essential role in students' learning process in this study, because it provided them with an opportunity to realize the importance of collaboration between different professionals (see Excerpt 12) and to understand the roles of their own occupation in a health care site (see Excerpt 13). Although we found that students' experiences in the interdisciplinary PBL were varied, their professional identities could be developed through reflection on their learning processes. In order to examine multiple perspectives of identity formation, a portfolio requires more interactional context (Monrouxe, 2009). The provision of feedback can be necessary for facilitating their reflection and professional identities, and the process of their reflection should work through interaction with facilitators or peers.

### Implications for Future Research

The PBL tutorials are regarded as places that students can gain a better understanding of the nature of an interdisciplinary approach to health care and their own health occupation through interactions with members from different disciplines (see Excerpts 5, 6, 12, and 13). The implications of this research are that this PBL format has the potential to enhance students' collaborative learning skills and professional identities. Their participation is situated in a cultural context.

The results were not generalizable due to the small number of participants and quite short length of the implemen-

tation compared with common PBL practice. However, the findings provided insights into students' participation and introspection during the discussions. For further research, it is worthwhile to conduct semi-structured interviews with students and tutors to make more in-depth exploration of the PBL pedagogical approach, including tutors' conceptions of teaching, students' conceptions of learning, cultural assumptions and process of professional identity formation.

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- Rintaro Imafuku** is an assistant professor in the Medical Education Development Center, Gifu University. He received his MA in Applied Linguistics from Monash University, and his PhD in Education from the University of Hong Kong. Currently, he is involved in PBL facilitation and medical interview training in undergraduate education in Japan. His main research interests are students' participation and interactions in a learner-centered context, formation of professional identities, health communication and interprofessional education. Address: Medical Education Development Center, Gifu University, 1-1 Yanagido, Gifu-shi, Gifu, 501-1194, Japan.
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- Ryuta Kataoka** is a professor in the Department of Dental Education, School of Dentistry, Showa University. He is in charge of undergraduate dental education and interdisciplinary education among the schools of dentistry, medicine, pharmaceutical sciences and nursing and rehabilitation. He is doing clinical activities in the area of oral medicine. His main research interests are students' critical thinking, group dynamics of PBL and e-portfolio. He is also in charge of the Program for Promoting Inter-University Collaborative Education entitled "Educating dentists who are able to work in the super-aged society utilizing ICT" of the Ministry of Education, Culture, Sports, Science & Technology in Japan. Address: School of Dentistry, Showa University, 1-5-8 Hatanodai, Shinagawa-ku, Tokyo, 142-8555, Japan.
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- Mitsuori Mayahara** is an assistant professor in the Department of Dental Education, School of Dentistry, Showa University, where he has been since 2008. He gained his DDS and PhD from Showa University in 2000 and 2004 respectively. He was involved in education and research in the Department of Oral Histology at Showa University from 2004 to 2008. His main research interests are dental education, interprofessional education and e-learning. Address: School of Dentistry, Showa University, 1-5-8 Hatanodai, Shinagawa-ku, Tokyo, 142-8555, Japan.

**Hisayoshi Suzuki** is an associate professor in the Department of Occupational Therapy, Showa University, where he has been since 2006. He received his MEd from Tokyo Gakugei University in 2000, and his PhD in Medical Science from Showa University in 2005. His main research interests are occupational therapy education, health professional education and inter-professional education. Address: Department of Occupational Therapy, Showa University, 1865 Tokaichibacho, Midori-ku, Yokohama-shi, Kanagawa, 226-8555, Japan.

**Takuya Saiki** is an assistant professor in the Medical Education Development Center, Gifu University. His current work mainly focuses on researching in the fields of Medical Education and General Medicine, and he is also involved in undergraduate education such as medical interview training and delivering nationwide faculty development programs in medical education for Japanese health professionals. Address: Medical Education Development Center, Gifu University, 1-1 Yanagido, Gifu-shi, Gifu, 501-1194, Japan.

## Appendix

Students' contribution to the problem map (step 4) in Group 2.

