A Method and Tool to Promote Knowledge Brokering in Cross-Boundary Learning for Organizational Learning and Career Development

Kota Isomura*
Graduate School of System Design and Management, Keio University, Kanagawa, Japan

Nobuyuki Kobayashi
The System Design and Management Research Institute of Graduate School of System Design and Management, Keio University, Kanagawa, Japan

Seiko Shirasaka
Graduate School of System Design and Management, Keio University, Kanagawa, Japan

Makoto Ioki
Graduate School of System Design and Management, Keio University, Kanagawa, Japan

ABSTRACT

Workers who take classes outside their workplaces can advance their careers through the knowledge acquired in those classes. Additionally, organizations are also able to acquire knowledge from outside the organization through working learners. However, there are some problems such as weathering of experience and persecution when learners try to apply their newly gained knowledge. Although the effects and features of cross-boundary learning have been proved by previous studies, a concrete and practical method for solving the associated issues does not exist yet. This study thus analyzes knowledge brokering in cross-boundary learning aimed at promoting organizational learning and career development. To solve these problems, the authors developed a method and a tool. The method combines existing models, based on requirements such as "autonomously learn and practice," "understand the different values between communities," and "practice learning by his/her initiative." A tool to constantly review learners' experiences supports the execution of the method. As a result of a three-month experiment involving 49 working students of a graduate school, the authors confirmed that the use of the method and tool promoted knowledge brokering in cross-boundary learning. The authors expect that the method and tool will be utilized by individuals, graduate schools or companies.

Keywords: Cross-boundary learning, Knowledge brokering, Experiential learning, Job crafting.

1. INTRODUCTION

In enterprise management, incorporating new knowledge from outside the organization into organizations is key for innovation (Tsai, 2001). For instance, organizations innovate by utilizing new knowledge acquired by workers learning outside their respective organizations. Studies have been carried out on key persons to incorporating external information, personal connections, and knowledge into organizations. They are typically called gatekeepers (Allen & Cohen, 1969) or structural hall (Burt, 1992). From the organization's viewpoint, Matsuo (2009) defined organizational learning as: knowledge gained by individuals and groups that is shared among groups and organizations, and institutionalized as routines or rejected, changes to knowledge, beliefs and actions of organization members. Anatan (2013) proposed a framework for promoting knowledge transfers between industry and university. That is, organizations require external knowledge for innovation.

On the other hand, in terms of career development, it is important for individuals to spontaneously develop their careers under intense environmental changes (Hall, 2003). The concept of such career development is called protean career (Hall, 2003) or boundaryless career (Arthur, 1994), both of which show an attitude not confined to traditional organizational boundaries. In Japan, the main part of career development is based on on-the-job-training, which is carried out in daily work. However, this has become less functional in situations described by the above-cited studies. Individuals' access to diversified growth opportunities outside the organization, rather than organization-led career development, is now required (Japan Ministry of Economy, Trade and Industry, 2018). That is, knowledge from outside organizations is required for career development.

From the above, both innovation and career development require knowledge from outside organizations. Under these circumstances, the authors focus on the importance of cross-boundary learning. This is because, through cross-boundary learning, individuals can make use of their experiences outside their organizations for advancing their careers. Moreover, another reason is that organizations can also acquire various types of know-how from outside the organization. Cross-boundary learning represents a series of processes in which workers go back and forth beyond the boundaries between "the situation they are in compliance" and "other circumstances" (Ishiyama, 2018b)." The situation in which they are in compliance represents a workplace where individuals usually work , while other circumstances are, for example, side jobs, study groups, or graduate school.

The process of cross-boundary learning involves the action of knowledge brokering, defined as "brokering and propagating the practice of one community to another community" (Wenger, 2000). For example, knowledge brokering is the action of taking the skills or information learned at graduate school by workers back to their own workplace and utilizing it for their jobs. In this way, knowledge brokering leads to organizational learning and career development.

However, based on a qualitative survey of cross-boundary learners, Ishiyama (2013, 2018b) pointed out that the weathering of experiences and persecution are hindrances to cross-boundary learning. The weathering of experience is a phenomenon in which learners no longer continue to be motivated to learn and gradually forget their experiences

in ordinary workplace situations. Persecution is the resistance to other practices in the organization, which happens when a cross-boundary learner tries to broker knowledge. These problems represent a great opportunity loss for both organizations and individuals, as they hinder organizational learning and career development.

Based on the above, this study aims to promote organizational learning and spontaneous career development through cross-boundary learning. For this purpose, it proposes a method to solve problems such as weathering of experiences and persecution and to promote knowledge brokering. Specifically, the method and tool allow cross-boundary learners to constantly review their experiences and organize their thoughts.

Cross-boundary learning has been proven effective by previous studies. It enables learners to establish their careers (Araki, 2007), have positive influence on their jobs (Ishiyama, 2018a), and improve their abilities (Ishiyama, 2018b). It has also been proposed that the experiential learning cycle (Kolb, 1984) is progressing in cross-boundary learning (Ishiyama, 2018b). Additionally, Ishiyama (2013) specified the behavior of knowledge brokers. Although the effects and features of cross-boundary learning are shown in these studies, concrete and practical methods for solving problems such as the weathering of experiences and persecution have not been hitherto presented. Furthermore, countermeasures for these problems have not been provided. In light of the above, this study contributed to solving these two problems of cross-boundary learning and proposing a concrete and practical method to promote knowledge brokering.

This paper consists of five sections. The second section reviews previous relevant studies and the third describes the requirements and contents of the proposed method. The fourth section describes the procedures and results and discusses the survey on understandability, usability, and effectiveness of the proposed method. The final section concludes the paper.

2. EXPLANATION OF BASE CONCEPTS

This chapter describes three concepts of previous studies that form the basis of the proposal of this study.

The first concept is the experiential learning cycle model, which is a "process of making lessons learned from experience through reflection" (Kolb, 1984). As shown in Figure 1, experiential learning progresses by cycling through of four processes: concrete experience, reflective observation, abstract hypothesis, and active testing.
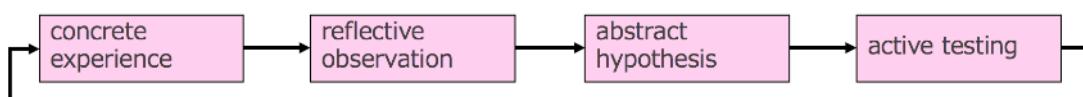

Figure 1. Experiential learning cycle model (based on Kolb, 1984)

Ishiyama (2018b) presented the proposition that the experiential learning cycle is progressing into cross-boundary learning. Figure 2 shows the application of the experiential learning cycle to cross-boundary learning. The process of active testing crosses the boundary of the community. That is, the learner plans active testing of knowledge and lessons learned from the external community in to link to the internal

community. The same is true for cases where the internal and external communities are swapped.

This study uses the experiential learning cycle model as a process to learn and practice autonomously, but it is necessary to improve the method of crossing community boundaries in the experiential learning cycle.
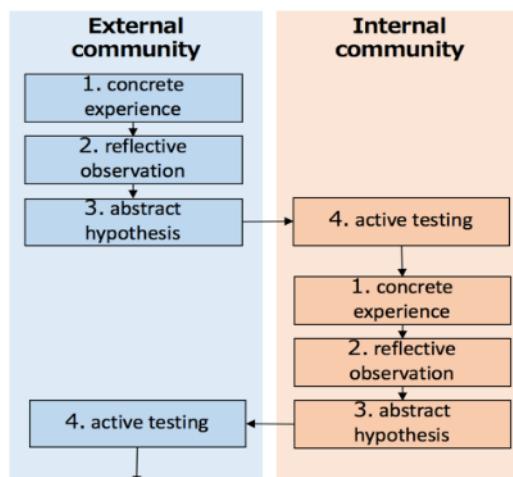

Figure 2. Experiential learning process in cross-boundary learning

The second concept is the knowledge broker model, defined as the process of introducing the practices of the external community to the internal community (Ishiyama, 2013). As shown in Figure 3, knowledge broker model consists of processes such as acceptance of various values, knot-working, integration of various values, action of knowledge brokering, and change in the community. This study uses the knowledge brokering model as the method to understand differences in community values, but it is necessary to more clearly specify the method of examining the action of knowledge brokering.
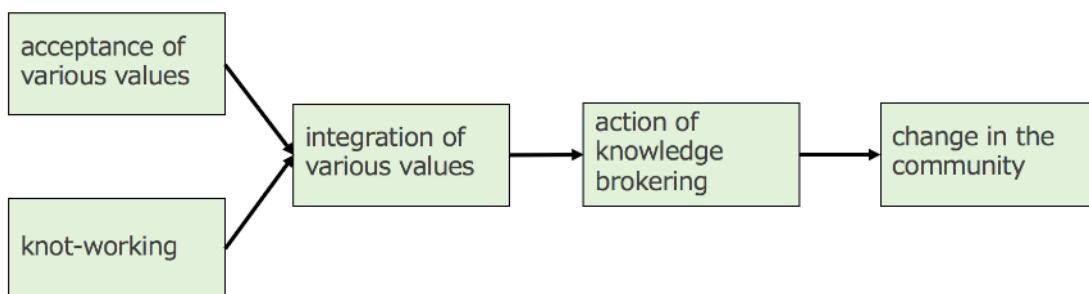

Figure 3. Knowledge broker model (based on Ishiyama, 2013)

The third concept is the job crafting model, defined as the method of the physical and cognitive changes individuals make in the task or relational boundaries of their work (Wrzesniewski, 2001). As shown in Figure 4, by changing the boundaries of tasks and the quality and quantity of human relations, ideas such as meaning of work and work identity change. Then, changes in ideas also provide feedback for practices. This study uses the job crafting model as the method to actively practice learning, but it is necessary to improve the method of considering behaviors based on differences in community values.
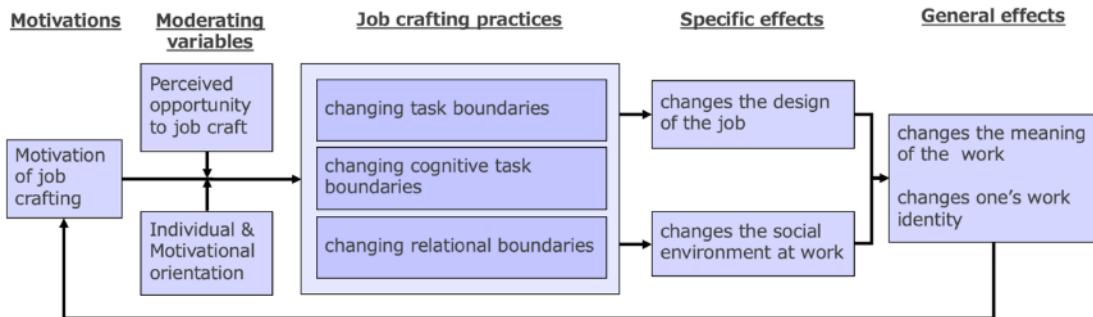
Figure 4. Job crafting model (based on Wrzesniewski, 2001)

3. PROPOSAL OF METHOD AND TOOL
3.1 Overview
This section considers a concrete and practical method and tool to solve problems such as weathering of experiences and persecution that inhibit cross-boundary learning. The method and tool combine existing models based on requirements such as "autonomously learn and practice," "understand the different values between communities," "practice learning by his/her initiative." The authors subsequently present the requirements for the proposal by clarifying what it should solve. The content of the proposal consists of three elements: a process to satisfy the requirements, a method to support the process, and a tool to support the method (Martin, 1994). After describing how to construct these, the subsequent sections show concrete proposal contents in terms of process, method, and tool.

3.2 Requirements
As previously mentioned, phenomena such as weathering of experiences and persecution hinder cross-boundary learning. The authors positioned these problems into the process of cross-boundary learning and clarified the requirements that the method and tool should satisfy to solve them. Figure 5 shows the results of these considerations.

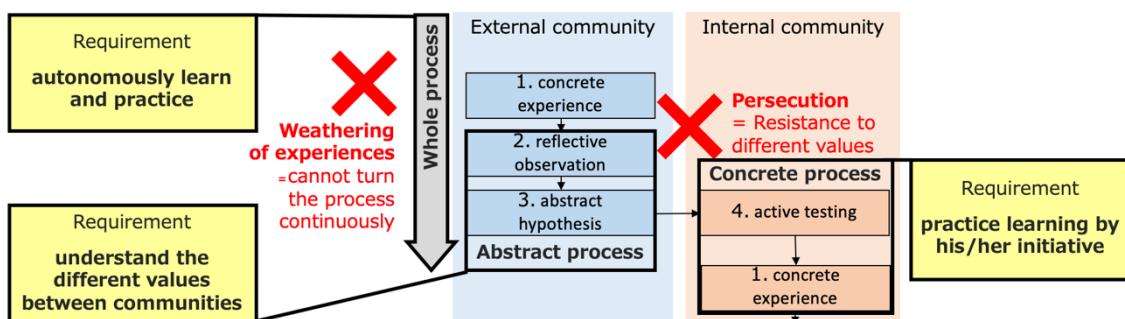**Figure 5. Problems in cross-boundary learning and requirements to solve them**

First, the authors position the problems into the process of cross-boundary learning. In the process of cross-boundary learning, weathering of experiences can be interpreted as "cannot turn the process continuously." Persecution can be interpreted as "resistance to different values of the community that arise in the active testing process."

Second, the authors specify the requirements the method and tool should satisfy to solve the problems. Since the experiential learning cycle can be divided into abstract (reflective observation and abstract hypothesis) and concrete processes (active testing and concrete experience), the requirements are defined from the three perspectives of entire, abstract, and concrete processes. From the viewpoint of the entire process, the requirement is to "autonomously learn and practice." This is because due to weathering of experiences, motivation decreases over time, which is caused by the inability to continuously turn cross-boundary learning process throughout the process.

  From the viewpoint of the abstract process, the requirement is to "understand the different values between communities." This is because persecution is triggered by resistance from the members of the internal community in the active experiment process due to learners' lack of understanding of the different values in the internal and external communities. From the viewpoint of the concrete process, the requirement is to "practice learning by his/her initiative." This is because, as a common feature with weathering of experiences and persecution, it is not possible to change the work from the conventional method in the active testing process unless learners know how to apply and implement the learning by themselves. Even if learners understand the differences in the values of communities, unless they can concretely plan and implement how to change the current work, they cannot make a change.

3.3 Construction method

The authors believe that the three models mentioned in the second section are effective to satisfy these three requirements. That is, the experiential learning cycle model meets the requirement to "autonomously learn and practice." The knowledge brokering model meets the requirement to "understand the different values between communities." The job crafting model meets the requirement to "practice learning by his/her initiative." What is common to the three models is that there are interactions between changes in the abstract (thought, idea) and concrete (behavior, experience) levels. Focusing on the similarity between the elements of the three models, the authors integrated them as shown in Figure 6 and created the method and tool learners can utilize. Table 1 presents the overview of the proposed method and tool.
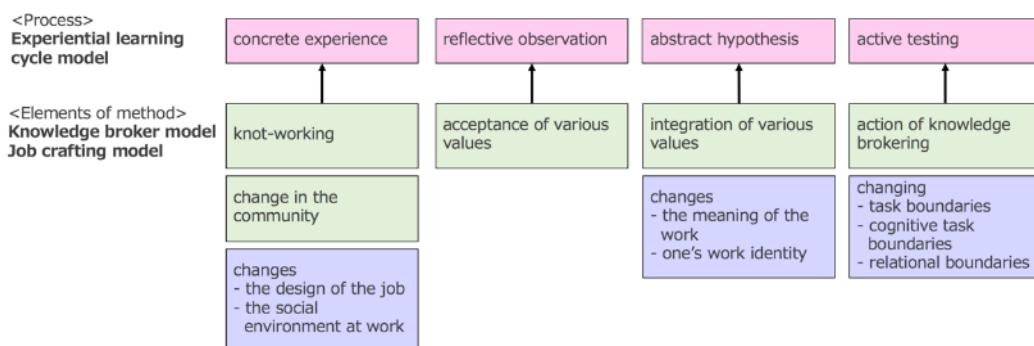

Figure 6. Integration of the three models

Table 1. Proposal contents

Process		Method	Tool
External Community	Concrete experience	The learner reviews his/her experience in the external community.	Parallel diary
		The learner reviews specifically on actions.	
		The learner reviews specifically on the human relations.	
	Reflective observation	The learner reviews knowledge and lessons from the experience.	
		The learner identifies the sense of difference felt in the experience.	
	Abstract hypothesis	The learner considers his/her identity in the background of the sense of difference.	
		The learner considers the values of the external community in the background of the sense of difference.	
		The learner considers his/her purpose of activities at the external community.	
Internal Community	Active testing	The learner sets up goals in order to achieve the purpose of the internal community.	
		The learner determines his/her action for the goal.	
		The learner determines the human relations for the goal.	
		The learner considers the manner to communicate based on the values of the internal community.	

3.4 Process

This study positions the experiential learning cycle model as the process that a learning person explicitly executes for knowledge brokering. This is because the learner can broker knowledge between communities by using the experiential learning cycle alternately in the internal and external communities.

3.5 Method

To support the experiential learning cycle, the method shows what should be considered and in which order for each process. Figure 7 is the model diagram of the method constructed by the authors with reference to the knowledge broker and job crafting models.
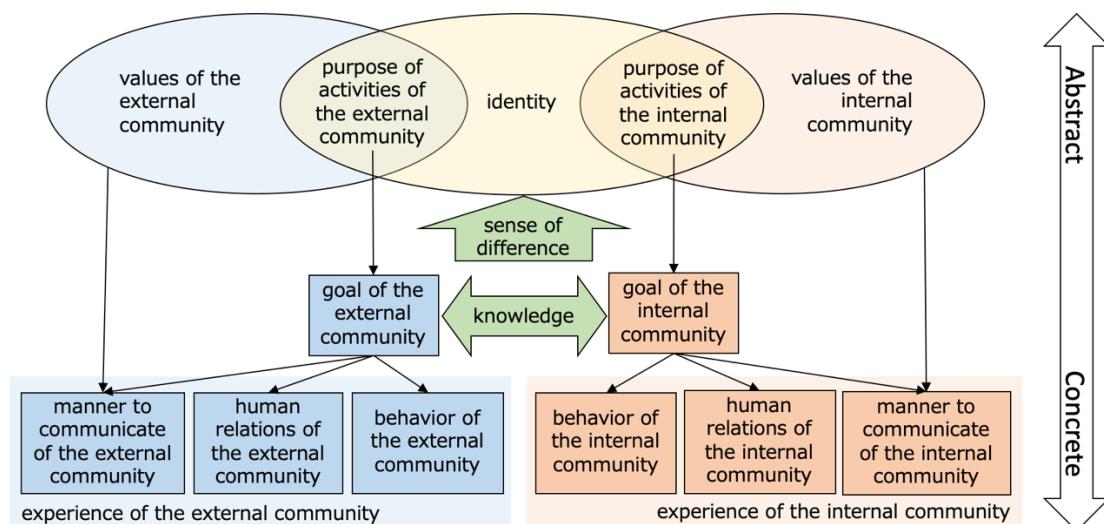
Figure 7. Method to promote knowledge brokering

The following shows the content of the method over the experiential learning cycle process, that is, for practicing learning of the external community in the internal community. The model diagrams in Figure 8 shows the correspondences between each process and the elements of the method to be considered.
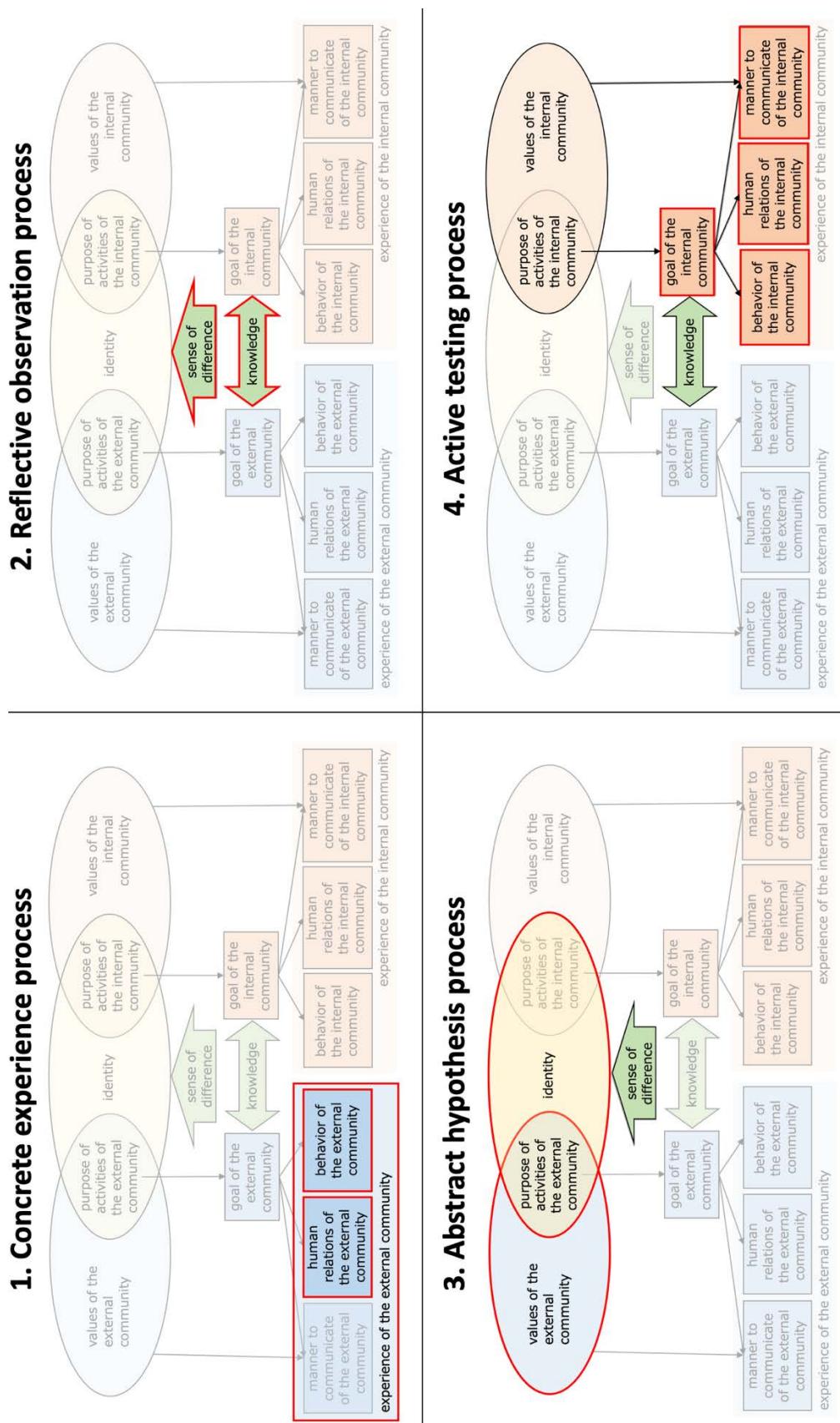
Figure 8. Correspondences between processes and elements of the proposed method

In the concrete experience process, the learner specifically reviews his/her experience from the viewpoints of *behavior in the external community* and *human relations in the external community*. In the reflective observation process, the learner reflects on the *knowledge* obtained from the experiences and *sense of difference* the learner felt. In the abstract hypothesis process, the learner considers the reasons for the *sense of difference* from the viewpoints of his/her *identity*; ability, aim, or thoughts and *values of the external community*; and goals, needs, or thoughts. Then, the learner considers his/her *purpose of activities in the external community* that can balance the identity and values of the external community. In the active testing process, the learner sets up a *goal of the internal community* to make use of *knowledge* obtained in the external community to achieve his/her *purpose of activity in the internal community*. Then, to achieve the *goal in the internal community*, the learner plans his/her *behavior in the internal community* and *human relations in the internal community*. In addition, the learner considers *manner to communicate in the internal community* based on *values of the internal community* to convince and make colleagues understand.

These are the process and the method for practicing learning from the external community in the internal community and vice versa. When practicing learning from the internal community in the external community, same method can be used by swapping terms *internal* and *external*.

3.6 Tools
To support the execution of the method, the authors created a tool called "parallel diary," which consists of 15 questions. As shown in Figure 9, periodically using the parallel diary such as once a week, the learner reviews his/her experiences both in the internal and external communities. In response to questions based on the method, the learner records the concrete experience, extracts the learning from the experience, and plans practice.
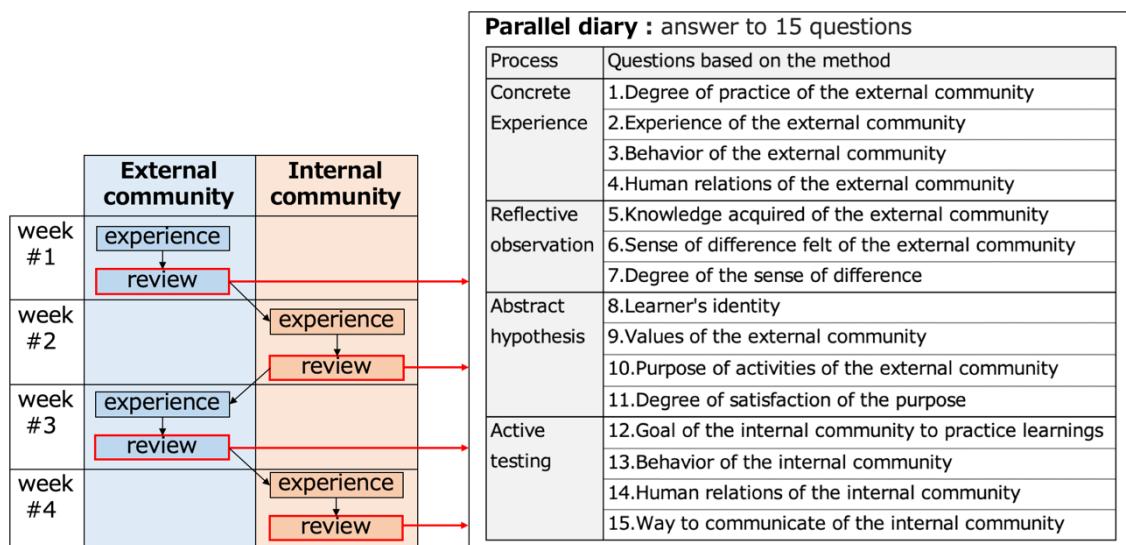

Figure 9. Periodic review using the parallel diary

4. EVALUATION
4.1 Evaluation procedure

To evaluate the method and tool proposed in Section 3, the authors conducted the experiment survey in Figure 10.
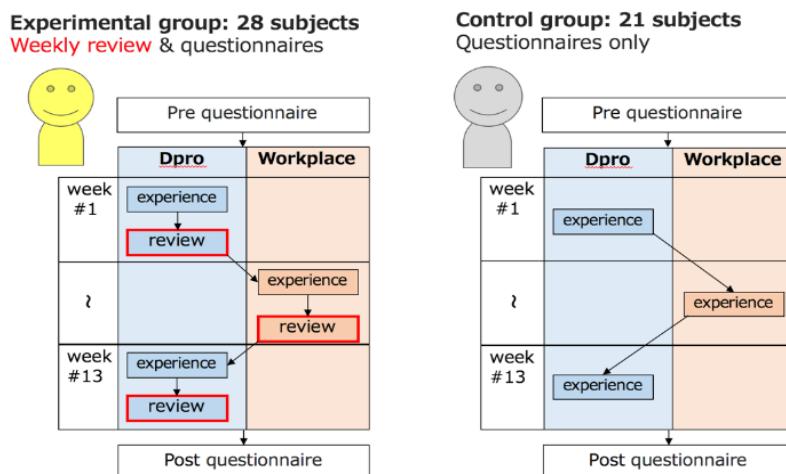

Figure 10. Experiment procedure for evaluation

The subjects were 49 working students at the Graduate School of System Design and Management, Keio University. The authors conducted the experiment over three months. The contexts of the experiment were the school program "design project (Dpro)" as the external community and workplace of each subject as the internal community. Dpro is a learning program based on project teams that aims to design products or services that bring new value or value changes to the society by appropriately using the "system and design thinking" taught by Keio University (Ioki, 2016). The program took place for four months from the middle of April 2018 to the middle of August 2018. In the first month, students learn thinking methods through lectures and exercises. From the second month, for three months, the students organize teams of six people and design solutions. The experiment took place from 13th May 2018 to 12th August 2018.

The subjects were those who volunteered to participate in the experimental group or the control group from among the 52 working students participating in Dpro. Table 2 shows aggregation for attributes of the subjects. In the experimental group, 28 subjects reviewed their experiences by using the method and tool once a week during the program and also answered the questionnaires before and after the program. In the control group, 21 subjects did not use the method and tool but answered questionnaires before and after the program. The answers to the questions were on a six-point Likert scale.

Table 2. Aggregation for attributes of the subjects

		Experimental		Control		Total				Experimental		Control		Total	
		n	%	n	%	n	%			n	%	n	%	n	%
Total		28	57%	21	43%	49	100%	Industry	Service	9	18%	8	16%	17	35%
Gender	Male	15	31%	14	29%	29	59%		Manufacturing	6	12%	2	4%	8	16%
	Female	13	27%	7	14%	20	41%		Public	2	4%	3	6%	5	10%
Age	20-29	4	8%	5	10%	9	18%		Finance	3	6%	2	4%	5	10%
	30-39	16	33%	6	12%	22	45%		Software	2	4%	2	4%	4	8%
	40-49	7	14%	7	14%	14	29%		Media	2	4%	1	2%	3	6%
	50-59	1	2%	3	6%	4	8%		Commerce	2	4%	1	2%	3	6%
Position	Employee	17	35%	7	14%	24	49%		Medical	1	2%	1	2%	2	4%
	Middle managemnt	8	16%	8	16%	16	33%		Education	1	2%	0	0%	1	2%
	Executive officer	3	6%	6	12%	9	18%		Construction	0	0%	1	2%	1	2%

The authors evaluated the results mainly by t-tests. As shown in Figure 11, t-tests compared the results of the questionnaires before and after the program and verified the significant differences respectively in the experimental and control groups. The authors judged each evaluation item to have an effect on the method when there was significant difference only in the experimental groups. This is because if there is a significant difference in both groups, it is interpreted that it is not the method but the program that has an effect of improvement. Since there were no significant differences in both groups, it can be interpreted that neither the method nor the program had an effect on improvement.
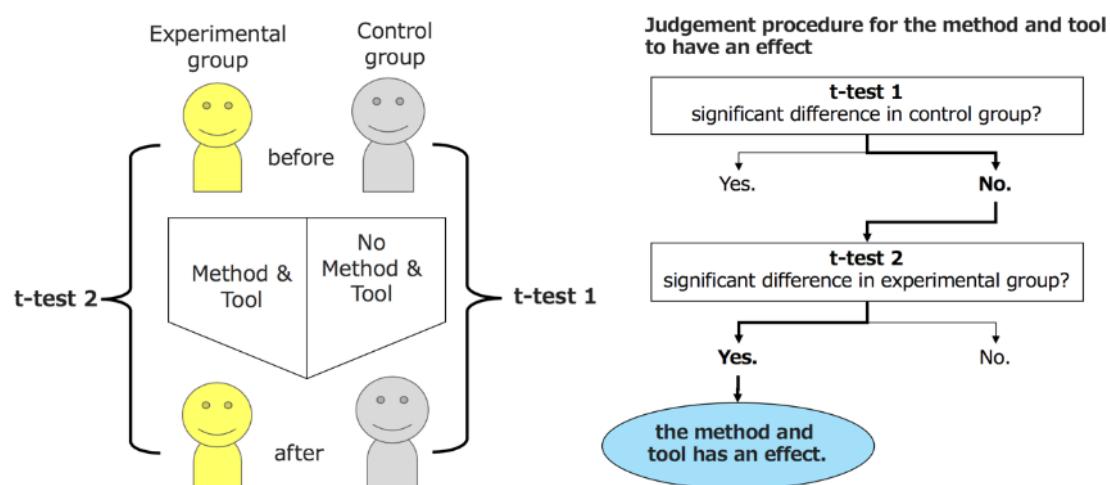

Figure 11. Procedure for determining experiment results

The evaluation criteria for the experimental group showing significant differences was based on a significance probability of 5% using the Holm method (Holm 1979). On the other hand, the evaluation criteria for the control group was based on a significance probability of 5%. The Holm method was not used for the control group because it would cause the number of evaluated items not significant in the control group to increase and, as a result, the range for which the method is erroneously considered to be effective would expand.

The following consists of the verification of the method and tool: whether they satisfy the defined requirements and the validation of the method and tool (i.e., whether they achieve the purpose of this study).

4.2 Results of verification of the method and tool
For the verification, the authors evaluated the method and tool from the viewpoints of understandability, usability, and effectiveness of requirements.

The understandability evaluation was based on a six-point assessment of the ease of understanding for each question of the tool (Table 3). The usability evaluation was based on a six-point assessment of the ease of answering each question (Table 3), the selection choice of and reason for the most difficult question to answer (Table 3), and time taken for the tool usage (Table 4). The assessments are judged to be understandable if they exceed the 3.5 value.

Regarding the assessment for understandability (Table 3), the average of all questions was 4.5 and each question item also exceeded 3.5, so understandability was confirmed. For ease of answering (Table 3), the average of all questions was 3.9, so ease of answering was confirmed. Question 9 and 10 scored 3.5 points, meaning there is room for improvement.
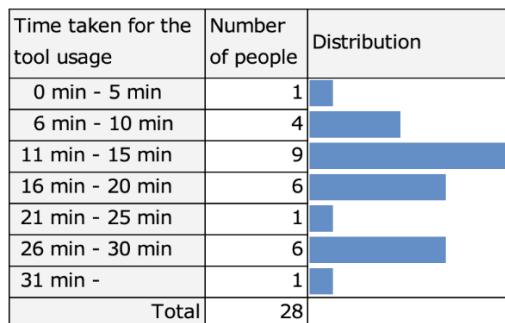
As for the choice of the most difficult question to answer (Table 3), several subjects choose question 5 (4 votes) and question 6 (9 votes) as the most difficult question to answer. The reasons for question 5 were opinions such as "It is difficult to consider the knowledge or lessons I can practice in the workplace" or "It is necessary to abstract experiences in the external community." The reasons for question 6 were opinions such as "It does not always have a sense of the difference of the external community."

Table 3. Understandability and usability for each question

Process	Questions based on the method	Understandability — Degree of Understandability — 6-point assessment	Usability — Degree of Ease — 6-point assessment	Usability — Difficult Question — Number of people
Concrete Experience	1.Degree of practice of the external community	4.2	4.0	0
	2.Experience of the external community	5.0	4.5	1
	3.Behavior of the external community	5.0	4.6	1
	4.Human relations of the external community	4.6	4.0	1
Reflective observation	5.Knowledge acquired of the external community	4.9	4.2	4
	6.Sense of difference felt of the external community	4.1	3.6	9
	7.Degree of the sense of difference	4.5	4.1	1
Abstract hypothesis	8.Learner's identity	4.0	3.6	1
	9.Values of the external community	4.0	3.1	2
	10.Purpose of activities of the external community	3.7	3.1	1
	11.Degree of satisfaction of the purpose	4.6	3.9	0
Active testing	12.Goal of the internal community to practice learnings	4.6	3.9	2
	13.Behavior of the internal community	4.9	3.9	1
	14.Human relations of the internal community	4.8	3.7	2
	15.Way to communicate of the internal community	4.4	3.6	2
	Average	**4.5**	**3.9**	

The distribution of the time taken for a one-time tool usage (Table 4) was shows average of 20 minutes, a minimum of 5 minutes, and a maximum of 60 minutes. The average of 20 minutes can be acceptable as review work once a week.

Table 4. Distribution of time taken for one-time the tool usage

Time taken for the tool usage	Number of people	Distribution
0 min - 5 min	1	
6 min - 10 min	4	
11 min - 15 min	9	
16 min - 20 min	6	
21 min - 25 min	1	
26 min - 30 min	6	
31 min -	1	
Total	28	

Effectiveness evaluation was conducted using t-testing to confirm whether the abilities of the experimental group related to the three requirements improved significantly or not after the experiment. The three requirements are "autonomously learn and practice," "understand the different values between communities," and "practice learning by his/her initiative." The evaluation items consist of a self-assessments about the abilities needed for the above requirements (items of A, B-a, B-b, C) and the abilities needed for the components that realize each requirement. The authors created the questions on the components with reference to the base concepts in Section 2.

The authors adapted Holm's method (Holm, 1979) to the items with less than 1.3% significance because the maximum was 3.1% among the items with significance probability less than 5%, it is necessary to choose one as there is no significant difference between two items with the same significance. However, because it was not possible to choose one, all items with 3.1% were excluded from the analysis. In addition, there are also two items with 1.8% significance that were also excluded from the method.

Table 5 shows the results of the t-test on effectiveness for "autonomously learn and practice." It confirmed that the method and tool have an effect regarding the requirement of "autonomously learn and practice" and component item A2. A1 can be interpreted as an improvement effect by participating in the program. That is because there are significant differences in both groups. Further, it is suggested that the method and tool have an effect regarding component items of A3 and A4 because only the experimental group has a significance probability below 5%.

Table 5. Results of t-test on effectiveness for "autonomously learn and practice"

Evaluation items for verification of "autonomously learn and practice"	Control group: n=21		Experimental group: n=28			Effect of the method and tool
	Difference in average	Significance probability (two-sided)	Difference in average	Significance probability (two-sided)	Significance difference by Holm method	
A: The learner can autonomously learn and practice.	6.6%	0.509	29.2%	0.006	Yes	Yes
A1: The learner can look back specifically on actions.	45.7%	0.000	34.8%	0.000	Yes	
A2: The learner can analyze experience and understand their meaning.	14.1%	0.092	25.1%	0.000	Yes	Yes
A3: The learner can extract knowledge and lessons from experience.	13.6%	0.127	20.6%	0.018		
A4: The learner can plan practice of learning in the internal community.	-4.7%	0.664	18.9%	0.031		

Table 6 shows the results of the t-test on effectiveness for "understanding the different values between communities." It was confirmed that the method and tool have an effect regarding the requirements of "understand the values of the external community" and "learner can understand the values of the internal community" and the component items B2 and B3. Regarding component item B1, it can be interpreted as an improvement effect from participating in the program because there are significant differences in both groups. Further, it is suggested that the method and tool have an effect regarding component item B4 because only the experimental group has a significance probability below 5%.

Table 6. Results of t-test on effectiveness for "understand the different values between communities"

Evaluation items for verification of "understand the different values between communities"	Control group: n=21		Experimental group: n=28			Effect of the method and tool
	Difference in average	Significance probability (two-sided)	Difference in average	Significance probability (two-sided)	Significance difference by Holm method	
B-a: The learner can understand the values of the external community.	15.0%	0.126	22.3%	0.002	Yes	Yes
B-b: The learner can understand the values of the internal community.	11.4%	0.290	22.0%	0.010	Yes	Yes
B1: The learner can look back specifically on the relationship with others.	37.8%	0.000	37.0%	0.000	Yes	
B2: The learner can notice the values shared in the community.	13.3%	0.138	20.9%	0.003	Yes	Yes
B3: The learner can match his identity with the values of the community.	14.8%	0.125	18.3%	0.013	Yes	Yes
B4: The learner can consider the way of communicating based on the values of the community.	6.3%	0.557	20.1%	0.018		

Table 7 shows the results of the t-test on effectiveness for "practice learning by his/her initiative." It was not confirmed that the method and tool have an effect regarding the requirement of "practice learning by his/her initiative." However, it was confirmed that the method and tool have an effect regarding component item C5. For C4, it can be interpreted as an improvement effect from participating in the program because there are significant differences in both groups. Further, it is suggested that the method and tool also have an effect regarding component item C2 because only the experimental group has significance probability below 5%.

Table 7. Results of t-test on effectiveness for "practice learning by his/her initiative"

Evaluation items for verification of "practice learning by his/her initiative"	Control group: n=21		Experimental group: n=28			Effect of the method and tool
	Difference in average	Significance probability (two-sided)	Difference in average	Significance probability (two-sided)	Significance difference by Holm method	
C: The learner can practice learning by his/her initiative.	2.3%	0.832	15.5%	0.056		
C1: The learner can determine his/her goal in the internal community.	18.1%	0.096	9.5%	0.207		
C2: The learner can determine his/her action for the goal.	10.1%	0.327	17.6%	0.031		
C3: The learner can determine the human relations for the goal.	2.2%	0.824	9.3%	0.224		
C4: The learner can notice the change in his/her identity.	20.7%	0.019	22.4%	0.009	Yes	
C5: The learner can notice the change in the purpose of activities in the internal community.	11.9%	0.227	26.6%	0.002	Yes	Yes

4.2 Results of validation of the method and tool

In the validation, the authors evaluated the method and tool in three ways. The first was the extent and reason the experimental group thought that the method and tool contributed to knowledge brokering. The second was the choice and reason for the most effective question regarding knowledge brokering. The third was the t-test of the effectiveness for study purposes.

Table 8 shows the distribution of a six-point evaluation regarding to what extent the experimental group thought that the method and tool contributed to knowledge brokering (judged to contribute if the value exceeds the average of 3.5 points). As the mean was 4.3 and it means that they contribute and the reasons for the evaluation were opinions such as "By using the tool, I had the chance to look back on experience regularly," "By overlooking my experience, I was able to organize the purpose of the activities, my strengths, weaknesses, and values of the community," "I was able to think connecting the program and the workplace," and "I could firmly consider what I should do in the workplace."
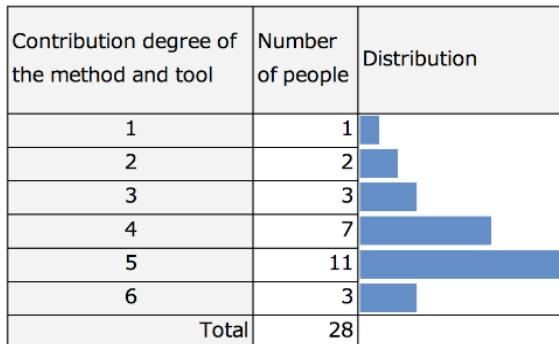
Table 8. Distribution of contribution of method and tool on knowledge brokering

Contribution degree of the method and tool	Number of people	Distribution
1	1	
2	2	
3	3	
4	7	
5	11	
6	3	
Total	28	

Table 9 shows the result of choosing the most effective question for knowledge brokering. Several subjects choose question 2 (5 votes), question 5 (11 votes), and question 12 (3 votes) as the most effective. The reason for question 2 was "I was able to look back on the experience." The reason for question 5 was "I was able to consider how I make use of learning from the external community for the internal community." The reason for question 12 was "Motivation of action improved by setting goals." These opinions match the reasons why the method and tool contributed to knowledge brokering.

Table 9. Most effective question for knowledge brokering

Process	Questions based on the method	Number of people
Concrete Experience	1.Degree of practice of the external community	1
	2.Experience of the external community	5
	3.Behavior of the external community	2
	4.Human relations of the external community	0
Reflective observation	5.Knowledge acquired of the external community	11
	6.Sense of difference felt of the external community	0
	7.Degree of the sense of difference	0
Abstract hypothesis	8.Learner's identity	1
	9.Values of the external community	0
	10.Purpose of activities of the external community	1
	11.Degree of satisfaction of the purpose	0
Active testing	12.Goal of the internal community to practice learnings	3
	13.Behavior of the internal community	2
	14.Human relations of the internal community	0
	15.Way to communicate of the internal community	0

*Not applicable:2

An effectiveness evaluation was conducted using a t-test for confirming whether "knowledge brokering," "organizational learning," and "spontaneous career development" significantly improved after the experiment. The procedure of analysis and judgment are the same as above.

Table 10 shows the results of the t-test on the effectiveness of "knowledge brokering" by using two evaluation items. The first is "The learner is practicing the learning from the external community at the internal community" and the second is "The members at the internal community are accepting learner's practice of learning from the external community." It was confirmed that the method and tool have an improvement effect.

Table 10. Results of t-test on effectiveness for "knowledge brokering"

Evaluation items for validation of "Knowledge brokering"	Control group: n=21		Experimental group: n=28			Effect of the method and tool
	Difference in average	Significance probability (two-sided)	Difference in average	Significance probability (two-sided)	Significance difference by Holm method	
D1: The learner is practicing the learning from the external community in the internal community.	17.2%	0.249	35.1%	0.005	Yes	Yes
D2: The members at the internal community are accepting learner's practice of learning from the external community.	15.6%	0.321	32.4%	0.010	Yes	Yes

Table 11 shows the results of the t-test on effectiveness for "organizational learning." Regarding the organizational learning due to knowledge brokering, evaluation criteria consist of whether the learner's procedure, content, purpose in the workplace have changed due to cross-boundary experiences. It was not confirmed that the method and tool have an overall improvement effect but were suggested to have an effect on E1 because only the experimental group has significance probability below 5%.

Table 11. Results of t-test on effectiveness for "organizational learning"

Evaluation items for validation of "organizational learning"	Control group: n=21		Experimental group: n=28			Effect of the method and tool
	Difference in average	Significance probability (two-sided)	Difference in average	Significance probability (two-sided)	Significance difference by Holm method	
E1: Procedures of work have been changed due to the cross-boundary experience.	14.6%	0.372	34.7%	0.025		
E2: Contents of work have been changed due to the cross-boundary experience.	12.1%	0.382	24.9%	0.064		
E3: Purpose of work has been changed due to the cross-boundary experience.	-1.7%	0.917	21.5%	0.083		

Table 12 shows the results of the t-test on the effectiveness for "spontaneous career development." Regarding spontaneous career development due to knowledge brokering, the authors used the protean career scale (Takeishi & Hayashi, 2013) as evaluation criteria. The protean career scale consists of the protean career self-oriented scale and the protean career value prioritized scale. It was not confirmed that the method and tool have an improvement effect.

Table 12. Results of t-test on effectiveness for "spontaneous career development"

Evaluation items for validation of "spontaneous career development"	Control group: n=21		Experimental group: n=28			Effect of the method and tool
	Difference in average	Significance probability (two-sided)	Difference in average	Significance probability (two-sided)	Significance difference by Holm method	
F1: Protean career self-oriented scale	4.9%	0.275	6.8%	0.104		
F2: Protean career value prioritized scale	6.8%	0.360	7.6%	0.121		

4.3 Discussion

In the verification, it was confirmed that the method and tool have an improvement effect on "autonomously learn and practice" and "understand the different values between communities" among the three defined requirements. Regarding "practice learning by his/her initiative," the improvement effects of the method and tool were not confirmed.

The authors' consideration of the reason that the improvement effect was not confirmed in "practice learning by his/her initiative" is as follows. In the method, "practice learning by his/her initiative" corresponds to an active testing process. Questions in the active testing process assumed the learner can answer questions 5, 9, and 10. On the other hand, they were difficult questions to answer. Thus, it is thought that the difficulty to answer questions 5, 9, and 10 was an inhibiting factor in considering active testing.

In the validation, it was confirmed that the method and tool have an improvement effect on knowledge brokering. The results of the questionnaire infer that some factors promote knowledge brokering due to using the method and tool. The first factor is promotion for constant reviewing the experience, which corresponds to the requirement of "autonomously learn and practice." The second factor is promotion for understanding of the values of the community, corresponding to the requirement of "understand the different values between communities." The third factor is promotion for consideration of behavior at the external community, which corresponds to the requirement of "practice learning by his/her initiative."

On the other hand, there was no significant improvement effect on "organizational learning " and "spontaneous career development." The authors expect the need for additional survey such as questionnaire statistical analysis and interviews to identify these factors. In addition, interviews with superiors and colleagues in the workplace of the subjects will promote a multi-viewpoint understanding of "organizational learning."

From the evaluation results, although it was confirmed that the proposed method and tool are effective for knowledge brokering, there is also rooms for improvements. As a result of the verification, questions 5, 6, 9, and 10 need to be improved to be answered easier. In addition, based on the results of the additional survey, the authors will consider an improvement of the method and tool to further promote "knowledge brokering," "organizational learning," and "spontaneous career development."

In addition, the questionnaire asked the experimental group about improvements in the method and tool. The representative opinions are as follows: "Reducing items to entry," "To further concretely examine the situations in the internal community to make use of knowledge and lessons," "Enriching cases that serve as a reference for answer," "Flexibly changing timing and communities to review," and "Having the opportunity of dialogue and coaching based on the results of the review." Based on these of opinions, the authors will improve the method and tool.

This study conducted the experiment in the graduate school as the external community. To further confirm the effect of this proposal, other external communities such as volunteer groups or side jobs should be considered.

5. CONCLUSIONS

This study aimed to promote organizational learning and spontaneous career development in cross-boundary learning. For this purpose, it proposed a method and tool to solve problems such as weathering of experiences and persecution and promote knowledge brokering. The method is a combination of existing models, namely the experiential learning cycle, knowledge broker, and job crafting models.

As a result of the evaluation, it was confirmed that the method and tool promote knowledge brokering. However, it was not confirmed that the method and tool have an effect on "organizational learning " and "spontaneous career development."

The authors expect that the method and tool will be utilized by individuals who want to learn outside the workplace, graduate schools who want to provide more practical learning, or companies who want to train their employees through cross-boundary learning.

The method and tool are thought to be effective for cross-boundary learning that learners frequently go back and forth between one community and another community, such as graduate school, volunteer groups or side jobs. On the other hand, the effect could be limited in certain type of cross-boundary learning that learners do not frequently go back and forth, such as one-time seminars.

Future study topics include the following;
- Identify factors of "organizational learning" and "spontaneous career development." The authors should use additional surveys such as questionnaire statistical analysis and interview to identify these factors.
- Improve the method and tool to further promote "knowledge brokering," "organizational learning," and "spontaneous career development." For "knowledge brokering," the authors expect improvement on the requirement of "practice learning by his/her initiative."
- Ascertain whether the method and tool are effective in external communities other than graduate schools. For example, volunteer groups or side jobs.

ACKNOWLEDGEMENT

REFERENCES

[1]   Allen, T.J., Cohen, S. (1969), "Information flow in R&D laboratories," *Administrative Science Quarterly*, *14*, 12–19.

[2]   Anatan (2013), "A proposed framework of university to industry knowledge transfer", *Review of Integrative Business and Economics Research*, *2*(2), 303–325.

[3]   Araki, J. (2007), "Study on the learning environment that encourages career establishment of individuals working in companies", *Japan Society for Educational Technology*, *31*(1), 15–27 (In Japanese).

[4]   Arthur, M.B. (1994), "The boundaryless career: A new perspective for organization inquiry," *Journal of Organizational Behavior*, 15(4), 295–306.

[5]   Burt, R.S. (1992), *Structural holes: The social structure of competition*, Cambridge: Harvard University Press.

[6]   Douglass T. Hall (2003), "The protean career: A quarter-century journey", *The Journal of Vocational Behavior*, *65*, 1–13.

[7] Holm, S. (1979), "A simple sequentially rejective multiple test procedure." *Scand. J. Statist.*, 6, 65-70.

[8] Ioki, M. (2016), "Example of an Innovative Thinking Education through System and Design Thinking", The 4th Annual Meeting of Innovation Education Society (In Japanese).

[9] Ishiyama, N. (2013), "How can brokers in external communities of practice introduce external practices into internal communities of practice?", *Japanese Journal of Administrative Science*, *26*(2), 115–132 (In Japanese).

[10] Ishiyama, N. (2018a), "Relationship between external activities including side job and Job crafting: Consideration of the effect of human resource development on main job", *Journal of Research for Labor in Japan*, *60*, 82–92 (In Japanese)

[11] Ishiyama, N. (2018b). *Mechanism of cross-boundary learning*, Fukumura Publishing (In Japanese)

[12] Japan Ministry of Economy, Trade and Industry (2018), "Study group report for strengthening human resources in Japanese industry", 1-63 (In Japanese).

[13] Kolb, D.A. (1984), *Experiential learning: Experience as the source of learning and development*, Prentice-Hall.

[14] Martin, J.N. (1994), "The PMTE Paradigm: Exploring the Relationship Between Systems Engineering Process and Tools", Presented at the INCOSE 4th Annual International Symposium.

[15] Matsuo, M. (2009), *Learning hospital organization: Patient-oriented structuring and leadership*, Dobunkan Publishing (In Japanese).

[16] Takeishi, E., Hayashi, Y. (2013), "Current status of employee's autonomous career consciousness—Application of protean career and boundary-less career concepts", *Career Design Research*, *9*, 35–48 (In Japanese).

[17] Tsai, W. (2001), "Knowledge transfer in intraorganizational networks: Effects of network position and absorptive capacity on business unit innovation and performance", *Academy of Management Journal*, *44*(5), 996–1004.

[18] Wrzesniewski, A. (2001), "Crafting a job: Revisioning employees as active crafters of their work", *Academy of Management Review*, *26*(2), 179–201.