

Consideration of the relationship between explicit knowledge and tacit knowledge in an intellectual task

Itsuki Takiguchi^{*1}

^{*1} Graduate School of Humanities and Studies on Public Affairs, Chiba University

In the execution of certain intellectual tasks, both explicit knowledge and tacit knowledge on the task are considered to be affecting. How does explicit knowledge and tacit knowledge affect the execution of task respectively? In this experiment, we investigated using four Origami tasks. As a result of the experiment, the following results were obtained. ① All the participants were able to complete the task. ② Variation in task time was large in tasks including new actions. From the above, it is concluded as follows. ① It is important that explicit knowledge is given in order to complete the intellectual task. ② If new information was included in the given explicit knowledge, tacit knowledge had a big difference in understanding and execution.

1. Introduction

When we look at the various actions from our morning getting up to sleep at night, it can be said that they are various kinds of task and accumulation of actions. In such task, even if it is an intellectual task that is somewhat complicated, such as cooking, sports, creative activities, if they are always doing them, we can do their intellectual task without any problems. This is because we have tacit knowledge about their intellectual task.

Tacit knowledge is knowledge of actions accumulated in the body by experience, and it is said that it is difficult to language and explain its contents. There is explicit knowledge as a knowledge division paired with this implicit knowledge. Explicit knowledge is a knowledge that can be symbolized, such as documentation or charting, and it can be said that it is relatively easy to acquire knowledge by looking at the symbolized one.

In the previous study, in a new intellectual task A and similar intellectual task B, if a person without knowledge of the intellectual task B experienced task B even once, they possible to perform intellectual task A as easily as those who have knowledge of task B.

As a problem of this experiment, it is not clear whether knowledge which is thought to be obtained by experiment is tacit knowledge or explicit knowledge, and the relationship between tacit knowledge and explicit knowledge for the intellectual task was unclear. It is a point.

Therefore, in this research, we set the explicit knowledge for a certain intellectual task on the foundation and see the relationship between tacit knowledge and explicit knowledge for the intellectual task by seeing how tacit knowledge is involved in the task process investigated.

In this thesis, tacit knowledge and explicit knowledge were defined based on Nonaka (1996).

2. Experiment

2.1 Purpose

We examine the relationship between explicit knowledge and tacit knowledge in the execution of intellectual tasks using intelligent task called Origami. Given the procedure of symbolized task as a folding chart, compare the differences between the experiment participants in the execution, so that tacit knowledge

It is clear whether it is involved.

In this research, we conducted experiments using four types of origami tasks, "Organ", "Yakko-san" "Ship" "Motorboat" (Figure 1, Figure 2, Figure 3, Figure 4). The four tasks used in this study were selected according to the classification of folding methods and the number of task procedures.



Figure 1 Organ



Figure 2 Yakko-san



Figure 3 Ship



Figure 4 Motorboat

First, similar to the classification of the basic folding method of origami in Maruyama (2013), we classify what is a plane deformed shape after deformation as a planar deformation and classify it as a three-dimensional deformed shape after deformation as a three-dimensional deformation.

Looking at the four types of tasks used in this experiment based on the above classification, "Organ" and "Yakko-san" contain both deformations of planar deformation and stereoscopic deformation, but mainly consists of three-dimensional deformation is there. On the other hand, "Ship" and "Motorboat" both contain only one deformation "turn over", but mainly consists of planar deformation.

Also, in "Organ" which is the problem of three-dimensional deformation, "Organ" has fewer task procedures and "Yakko-san" has more task procedures. Similarly, in "Ship" and "Motorboat" which is the problem of planar deformation, "Ship" has fewer task procedures and "Motorboat" has more task procedures.

If it is important to have formal knowledge about the task of folding origami, in the state given from the beginning in the formal knowledge of a fold, it is possible to fold each task to the end irrespective of participants. It is considered possible. In addition, the variation in the tasking time among experimental cooperators in each task is reduced, and it can be considered that all the participants can finish the task in a certain time. It is thought that the task time of each task is that the task time becomes longer in the order of ship, organ, motorboat, Yakko-san, from the difference in the number of task procedures and the difference in task procedure related to deformation.

2.2 Method

(1) Participant

Nine university students (4 men, 5 females, 19 to 21 years old) participated. Both were undergraduates enrolled at the Faculty of Literature, Chiba University.

(2) Procedure

Based on Takiguchi (2017), we set experimental recording method and experiment time. I asked the participants to fold the origami of Organ, Ship, Yakko-san, and Motorboat. I take a photograph of the situation, and then asked questions about the problem. The experiment time was 40 minutes.

Firstly, we presented subjects with a fold of the task and an origami. After telling participants to refer to folding charts and referring to the tasks, we asked the participants to start to break down the task and took a picture of the situation. The shooting was done from the front so that the hand of the subject could be confirmed. A measurement was started from the point of time when the subject touched the origami, and the measurement was terminated when the task was completed. After completing the assignment, I asked the subjects the following question about the subject.

- ① Have you ever faced a problem before?
- ② Did you know how to break the task?
- ③ Has there been a part that the instructions were difficult to understand about the fold of the task?
- ④ Were there any places where it was difficult to break up the task, and what was difficult if there were any?

After finishing the question on the subject, we moved to the next task.

After completing all four tasks, we asked questions about the folding charts of subjects by referring mainly to the illustration part and the sentence part of the folding drawing and asked the questioner about experiments finished.

The order of assignment was randomly determined for each subject and experiments were carried out.

2.3 Result

Tasking time of each task was measured based on captured images. The measured results are summarized in a table (Table 1). Mark of "experience" in Table 1, they have never been experienced yet and none that knows how to fold as ×, they have a memory like folded before but they do not remember how to fold at the moment as △, and they had folded and remembered how to fold as ○. Also, the skewness, kurtosis, average value, standard deviation, and coefficient of variation were determined for each task in Table 2 and summarized in a table (Table 2).

And a box-breaking graph was created. (Figure 5)

Table 1 Task time(sec) and experience of participants

ID	Organ		Yakko-san		Ship		Motorboat	
	time	experience	time	experience	time	experience	time	experience
A	133	×	264	×	134	×	413	×
B	158	×	156	△	206	×	469	×
C	90	×	104	△	115	×	241	×
D	111	○	178	×	336	×	199	×
E	95	×	158	△	128	×	279	×
F	155	×	122	○	191	×	291	×
G	170	×	156	○	187	×	426	×
H	163	△	221	△	273	×	667	×
I	153	×	209	×	164	×	608	×

Table 2 Analysis values for each tasks

	Organ	Yakko-san	Ship	Motorboat
skewness	-0.625	0.465	1.068	0.508
kurtosis	-1.420	-0.171	0.658	-0.905
average	136.444	174.222	192.667	399.222
standard deviation	28.768	47.208	68.059	153.608
coefficient of variation	0.211	0.271	0.353	0.385



Figure 5 Box plot of task time

Looking at the experience of Table 1, we can see that in this experiment there were none of the experimental collaborators who had previously experienced the creation of a Ship and a Motorboat. Also, at Yakko-san, many participants are not remembering how to fold at the moment but remember that they have experienced before, or they have remembered folding methods before.

From Table 3, it can be seen that the skewness and kurtosis of each task are within the range of ± 1.5 . Also, when comparing the values of average, standard deviation, and coefficient of variation for each task, you can see that the Organ, Yakko-san, Ship, Motorboat are increasing in that order in all the items.

As you can see from Figure 5, the Organ does not have much variation in task time, and he can be said that the variation in task time is small. For Ship, it seems there are variations in the tasking time compared to Organ and Yakko-san. It can be seen that the variation in the operation time of the Motorboat is larger than that of the other three. Also, it can be seen that there are no outliers for each task.

Regarding the question after the completion of each task, there were responses to Organ, Ship, and Motorboat for the part where the instruction of the folding chart was difficult to understand. For Organ, there are responses from five experimental collaborators, all of which are difficult to judge because there is no instruction as to whether to fold down by half or half against the folding method of the part corresponding to the keyboard part of the organ. It was an answer that it was. For Ship, there were responses from six experimental collaborators, all of which were answers that the instruction of the folding drawing was difficult to see, of which four were to fold only the top one of the overlapping parts. It was an answer that instructions were difficult to see. For Motorboat, eight replies from the participants replied that it was difficult to understand the instructions on the instructions that three of them will be turned upside down. The other 5 people answered that they had to worry about the order of folding up the left and right, and because they needed confirmation left and right unlike other tasks, they were caught in that place. There was no response from the participants to the Yakko-san.

Responses were obtained to Ship and Motorboat for places where it was difficult to break up the task. For Ship, there were responses from three people, and it was an answer that it was difficult to move all of them upside down. For Motorboat, there were responses from four people, and two of them answered that it was difficult to move upside down. The other two persons answered that the part folded so as to overlap on the left and right was hard to be folded due to a large number of papers overlapped and thick, which made it difficult to fold.

For the question after the task was completed, all the participants tasked while referring to illustrations mainly in the folding chart, and answered that the sentences were using it as an aid.

2.4 Discussions

Looking at the skewness and kurtosis values of each task in Table 2, we see that each task is within the range of ± 1.5 . Also, looking at Figure 5, it does not appear that there are large outliers for each task. From the above, it can be said that it is appropriate to use the average value as the representative value and the standard deviation or the variation coefficient as the comparison of the variation size, according to the normal distribution of the numerical distribution of the task time in each task.

Looking at the variation in the task time within each task seen in Figure 5, it seems that the variation is increased in the order of Organ, Yakko-san, Ship, and Motorboat. This is also evident from the comparison of the values of the coefficient of variation in Table 2. From this it can be said that if it is assumed that only formal intelligence is important in origami, the variation in tasking time among experimental cooperators in each task is reduced, and it is possible that all participants can finish task in a certain time. It can be said that the result was contrary to the assumed hypothesis. In addition, since the average value of each task increases in the order of Organ, Yakko-san, Ship, and Motorboat, it can be said that the total operation time in each task increases in the order of Organ, Yakko-san, Ship, and Motorboat. If the result is also important, when the task of each task is important, the result that Ship, Organ, Motorboat, and Yakko-san become larger from the difference of the number of task procedures and the task procedure related to the deformation. It is contrary to the assumption that it is obtained.

In addition, with regard to Yakko-san, it cannot be seen that some variations between each participant can clearly show that those who have experience clearly were able to complete task earlier. However, it can be considered that the task time of participants who have never folded a fellow before it is higher than the average value of all the parties supports the assumption to some extent.

It is thought that the reason why Ship and Motorboat task time was more than Organ and Yakko-san was that there was no person who experienced Ship or Motorboat, and there was no experience of "turn over". On the other hand, since it is totally uneven despite being a new movement to all participants, we thought that there was something different about understanding and execution of the new behavior.

3. Discussions

Summarizing the results obtained in this experiment, the following two points can be said.

- ① If you get the folding chart, that is explicit knowledge, of origami, you can complete the task even if it is a task that has never folded before.
- ② From the results of task time variation, Yakko-san, Ship, and Motorboat, not only explicit knowledge but also tacit knowledge influences execution and understanding of the task.

In this experiment, all the participants were able to complete all tasks to the last. At Takiguchi (2017) and Takiguchi (2018), we could not finish the task to the very end by presenting samples of the task, presenting information that is not complete with respect

to the procedure of folding and how to fold. From these facts, it can be said that presenting the procedure of folding and the written explicit knowledge of how to fold has had a big influence on executing inexperienced tasks.

It can be concluded that tacit knowledge has an influence on the execution and understanding of explicit knowledge, based on the comparison of the average value in Yakko-san and the task time with inexperienced persons, the magnitude of variations in Ship and Motorboat.

In this experiment, it was important that explicit knowledge was given to the completion of origami, but the result that tacit knowledge had an influence on understanding and execution of given explicit knowledge was obtained.

Whether intellectual task is carried out or not is important for completing the task whether explicit knowledge is given, but individual tacit knowledge brings about a big difference to the understanding and execution of given explicit knowledge can be concluded.

4. Conclusions

Ship and Motorboat 's "turn over" is not intended in this experiment, so care must be taken when performing similar experiments.

The introduction of new action tasked effectively as a reinforcement of the possibility that tacit knowledge has an important influence on the execution and understanding of formal knowledge about the relationship between formal knowledge and tacit knowledge for tasks. However, it was not possible to deny the possibility of having a negative influence in the experiment which was supposed originally, and attention is necessary for a similar experiment to be carried out in the future.

Also, I would like to pay attention to the point that the folding chart of Ship became difficult to see part by printing.

Participants were tasking on the task with reference to both the illustration part and the sentence part of the folded drawing. It can also be said that the fact that the sentence is difficult to see is that part of the function as a folding chart has been lost.

I think that we can see the implications of tacit knowledge in terms of what we have been devised to accomplish the task from the missing information..

References

- [Nonaka 1996] Ikujiro Nonaka, Hirotaka Takeuchi (Author) Katsuhiro Umemoto (Translation). Knowledge Creation Company 1996-03-21. Toyo Keizai Inc.
- [Maruyama 2013] Manami Maruyama. Formation of stereoscopic image: psychological study using origami paper Brush up seminar proceedings for young image researchers 76-79, 2013-03-14. For the brush up seminar steering committee.
- [Fukami 2000] Ezashi Fukami. Ogami Daizenshu. Narimido Publishing and Editorial Department (ed) Narumido Publishing
- [Ueda 1955] Jiro Ueda. New Origami Origami. 1955-06-01. Fukuinkan bookstore
- [Polanyi 1980] Michel Polanyi. Keizo Sato (Translation). Dimension of tacit knowledge: From language to non-language 1980-8-15. Kinokuniya Bookstore
- [Osaki 2009] Masauru Osaki. Understanding tacit knowledge Tokyo Keizai University Humanities and Natural Sciences (127). 21-39, 2009-03-04. Tokyo Keizai University
- [Igarashi 2012] Yuko Igarashi. A History of Origami and a Study on Origami as Child Care Education. Urawa Discourse (46). 45-68, 2012-02. Urawa University Junior College
- [Takiguchi 2017] Itsuki Takiguchi. Akinori Abe. A study on the influence of experiential knowledge on intellectual task. The conference proceedings of the National Convention of the Society of Artificial Intelligence JSAI 2017 (0), 4 L 23 - 4 L 23, 2017. General Society of Artificial Intelligence
- [Takiguchi 2018] Itsuki Takiguchi. Akinori Abe. A study on intellectual tasks influenced by the embodied knowledge. in New Frontiers in Artificial Intelligence. JSAI-isAI 2017 (Arai S., Kojima K., Mineshima K., Bekki D., Satoh K., Ohta Y. (eds)). Lecture Notes in Computer Science. vol 10838. pp. 51-62. Springer(2018)