A Method for Online Discussion Design and Discussion Data Analysis

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***Abstract*— The final goal of our research has been conducting research and development on a large-scale consensus support system in which we will introduce automated facilitators by applying deep learning technology. The aim of this paper is to present how to design discussions on the online discussion system which is not consisted by explicit framework and how to process those discussion data as training data of deep learning for the development of automated facilitation system. As a first step to attain a consensus formation, it is necessary to design discussions constructively. In order to do so, participants' opinions must be collected efficiently. The issue-based information system (IBIS) is a well-known efficient way to do this. In a discussion adopting the IBIS idea, participants can understand each other's opinions clearly and propose their new ideas smoothly. It is possible to annotate the word data collected from online discussions with the constituent elements of IBIS. The annotated data is reusable as training data of deep learning and intended for application to other systems as open data. Based on above, we conducted an online discussion design experimental method and examined online discussion with applying IBIS idea. Our experiments proved that it is possible to extract IBIS elements in non-framed online discussions.**

Keywords—Decision sciences, Decision support systems, Creative decision processes and interaction techniques, large-scale online discussion, issue based information system

I. INTRODUCTION

We conducted an experimental method of online discussion and its data processing as one of the steps to our final research goal; to create a large-scale consensus support system. [1] [12] [13] [14] Our ideal large-scale consensus support system makes it possible to collect numerous opinions from participants free of time and location restrictions. [16] [18] [21] [22] A feature of this system is "facilitator-mediating," which prevents flaming. "Flaming" which is making negative, inflammatory comments that provoke readers. Due to the anonymity of most online discussions, people easily post strong opinions. In our previous study, we focused on a facilitator's suppression effect on flaming and observed their effectiveness. [1] Suppressing flaming leads to more constructive and fruitful discussions, but we expect it presents more possibilities as a facilitator function, so we started to consider other possibilities for expanding our research vision.

Essentially, the most important role of a facilitator is to lead a discussion constructive. Focusing on that, we investigated related research and found one interesting study on the issue-based information system (IBIS) presented by W. Kunz and H. Rittle. [2] [3] The IBIS is a method of constructing and classifying the contents of participants' opinions in discussions with major component elements—*Issue*, *Position*, *Argument*—for tackling wicked problems. When introducing the IBIS into discussion, participants tend to create unexpected ideas or look at things from other points of view. Another advantage of the IBIS is that it enhances the transparency of discussion design. During discussions, transparency is a highly important factor in helping both participants and observers make decisions.

One curious discussion designing technique is called "dialogue mapping," proposed by J. Conklin. [4] [5] [6] When using this technique, a facilitator categorizes participants' comments into the following four elements: *Questions*, *Ideas*, *Pros*, and *Cons*. Then, the facilitator makes a figure showing which comment made to. The advantages of dialogue mapping are clarifying the positions of all the comments, establishing mutual understanding among discussion participants, and revealing the issues and ideas of the discussion topic.

Based on the advantages in real field discussions with dialogue mapping, we propose a discussion method with applying the dialogue mapping idea intended to form practical structures in online discussions by facilitators. [10] [17] We anticipated that the method—specifically when applying the IBIS idea and dialogue mapping—supports to collect constructive opinions in online discussions and make discussion structures systematically. Since real field discussions are different from online discussions in several points, we had to revise some points in the dialogue mapping technique for online discussions. Thus, we use human facilitators to extract IBIS elements from participants. In our study, we defined the IBIS into four elements: *Issues*, *Ideas*, *Pros*, and *Cons*, from the studies of both H. Rittle and J. Conklin. A detailed explanation is given in Section III.

The ideal vision of the large-scale consensus support system is automated facilitators promote constructive discussion. [11] [15] [19] [20] A large amount of actual discussion data is essential for the development of automated facilitations, and the data quality is as important as the quantity. Therefore,

the data should be processed properly for deep learning. We explain how we processed online discussion data for machine learning.

In this paper, we propose a discussion design method for online discussion intended to discussion structures, and the data processing method. The data was obtained from the discussions introduced our discussion design method. The rest of our study is explained in the following sections: Section II explains the online discussion system "D-Agree," which is used in this study, Section III describes the method of extracting IBIS elements in online discussions, Section IV explains our method of processing and examining online discussion data, and Section V concludes our research.

II. ONLINE DISCUSSION SYSTEM "D-AGREE"

We are currently developing an online discussion system called "D-Agree." D-Agree is an upgrade version from the "COLLAGREE" system that we had been conducting research and development on before. [5] [6] The main difference between D-Agree and COLLAGREE is server management. COLLAGREE's server is set up on a local computer, but D-Agree's server is cloud-based. Due to the limitation of local server capacity, sometimes we had to stop discussion on COLLAGREE. We expected the cloud-based server might solve this problem. Add to that, it has become possible that the related developers can manage the system from everywhere. All our most recent discussion experiments were carried out using D-Agree.

The flow of discussion style on D-Agree is as follows; participants can freely post their opinions on discussion titles (referred to as "Themes") in D-Agree. Figure 1 shows the user interface of D-Agree. There are three important areas in the discussion field: ①Theme, ②Post, and ③Thread. Participants can always check the discussion title in the "Theme" area, (Figure 1-①). The "Post" area, (Figure 1-②), is where participants post their opinions when they want to make a new thread. The Thread system on D-Agree, (Figure 1-③), is a place for setting a small theme for the main topic of discussion based on participants' ideas or issues and sharing their opinions with each other using some functions. In the Post area, a box is provided for posting a title. When the participants post some words on there, it becomes a thread subtitle.

One of the feature systems on D-Agree's interface is Thread structure. Figure 2 shows a functions' details in the thread area. One thread area appears when a participant posts their first opinion. Most of the time, the contents of the first post tend to be issues or ideas. Once a thread area is made, participants post their opinions using the "Reply" function. When opinions are posted in a thread area, each opinion is numbered (referred to as the "posting number"), as seen in Figure 2-①. Two buttons appear on the right side of each opinion. They are "Reply" and "Like!" buttons, shown in Figure 2-②,③. Participants post their opinions using the "Reply" function except for when making new thread; thus, both posters and observers can always check all the opinions. When participants want to mention some opinions indirectly, they can indicate them with their Posting Numbers; i.e., "I agree with the idea of Post No. XXX." The "Like!" button is for expressing agreement or interest in other people's opinions. The number of "Like!" is shown on each opinion, as seen in Figure 2-④, showing participants which opinions are the hottest at that moment.

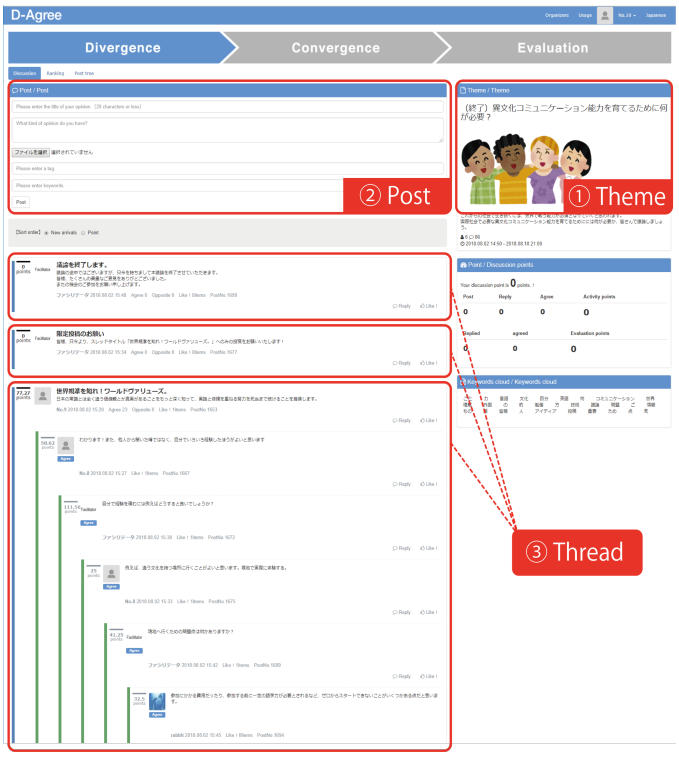

Figure 1. The User Interface of "D-Agree"

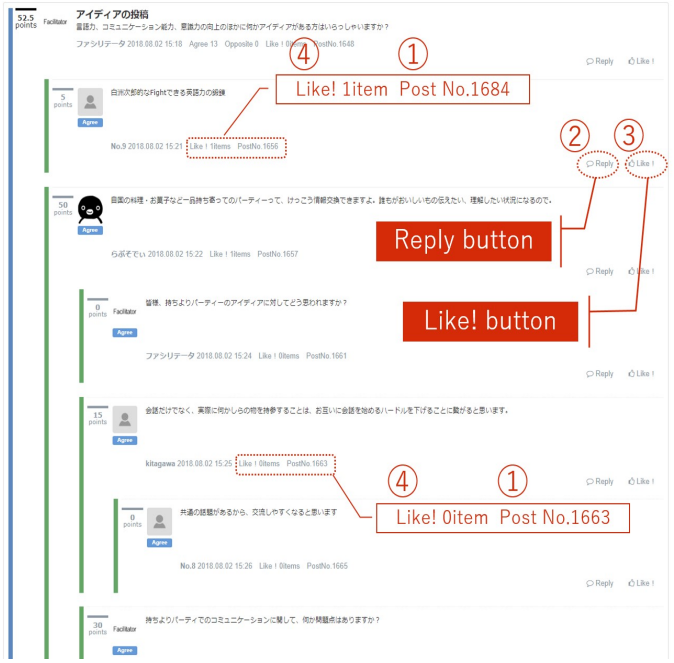

Figure 2. Detailed screenshot of the "Thread" area

III. Online discussion experiment

The main aims of our experiment in this time are to investigate the feasibility of constructing IBIS structures in online discussions and to study the effect of facilitation for extracting IBIS elements. The new point in this discussion design method is that instead of complex functions on the interface, facilitators prompt the participants to post their opinions based on the IBIS elements and make discussion structures naturally. In other words, we can obtain constructive opinions for making systematic discussion structures without using any framework on the interface. Thus, participants are free from complex operation.

Let us explain the detail of our online discussion experiment for making discussion structures. Firstly, we have to clarify what the components of IBIS structures are. IBIS structures consist of four elements in our study: *Issues*, *Ideas*, *Pros* (advantages, agreement, positives), and *Cons* (disadvantages, disagreement, negatives). However, IBIS components are defined differently depending on the researcher. Since J. Conklin's dialogue mapping is designed for structuring discussion, we mostly adopted his idea of IBIS components.

The participants in our experiments consisted of students, researchers, and office staff at the Nagoya Institute of Technology. Basically, they were only given the manual of the D-Agree system and instructed to post their opinions freely while paying attention to facilitator comments. They were not told about IBIS structures. Participants could set up their D-Agree user account. The required information to set up their account was their email address, username, and password. They did not have to use their real name for their username. Actually, almost all of the participants used a nickname for their username. The minimum number of participants was 5; the maximum was 9. The minimum duration of the discussions was 40 minutes; the maximum was 6 days. There were 5 experiments. Regarding the flow, participants began discussions by posting their opinions on a set discussion theme. We observed a trend in the discussion process. The beginning of a thread often started with Idea opinions, and after that the Idea was followed by Pros or Cons.

To extract elements sufficiently, we employed researchers from our team as human facilitators. In real field discussions, one of the main roles of a facilitator is giving a welcome and closing speech, lead a discussion to be fruitful and keeping time. Facilitators in our experiments covered such tasks, but their main role was to extract the four IBIS elements while observing entire discussions. Facilitators drew out participants' opinions by varying words as much as possible, which they did to avoid to losing participants' motivation. During a discussion, a facilitator frequently asks for new opinions; thus, a facilitator should intend to use the different words for avoiding to annoy participants. This flow above was repeated until the end of a limited time. Because the aim of the experiments within this time was to design discussions for making IBIS structures and to observe results, we did not conclude a consensus or make decision on any discussions. Our focus was the flow of the experiments.

As the evaluation criteria of discussion design, we adopt the number of IBIS elements in a discussion. As mentioned repeatedly, making structure is the key for constructive discussion. When we collect a large number of opinions classified to the IBIS elements, we can make well considered discussion structure. In other words, more constructive opinions inspire participants thinking. Add to that, regarding to the development of automated facilitation, we need learning annotated discussion data as much as possible.

IV. Data Analysis and results

A. How to process online discussion data

There are some advantages in discussions that use an online discussion system. Those advantages are: (1) ease of collecting discussion data—it is not necessary to take minutes, and the data is very versatile, (2) discussion data can be used as training data to develop an automated facilitator—data is useful for online discussion research, and discussion data can be used as training data for discussion support system development, which is our final research destination, especially for an automated facilitator mediation function. Therefore, we tried to do data processing with our original method, in which data was collected from our online discussion experiment. The method of our data processing is as follows.

i) Install "phpMyAdmin" to "Amazon Web Service" using GUI at "MYSQL" database.

ii) Export CSV format discussion data using the function in "phpMyAdmin."

iii) Encode characters in discussion data by using text editor.

iv) Remove line feed code from discussion data by self-made tool.

v) Sort discussion data into the thread structure by self-made tool.

The process from i) to v) is preparation for main data processing. Figure 3 is the processed datasheet that helps explain next step. After the preparation process from i) to v), all the opinions posed were classified into six elements: Facilitation (FA), Issue, Idea, Pros, Cons, and Not Applicable (N/A). In (Figure 3-①), we called this classification of procedures "Annotation." We shortened annotated minimal phrases from one sentence; thus, we often annotated multiple phrases on one posted opinion. When we found multiple elements on one posted opinion, we had to break down each element and annotate each one of them. To reveal the annotation process, classifying phrases to the elements, we filled in the "Detail" section with the annotated phrases. In (Figure 3-②), full sentences of one posted opinion are in the "Text" section, (Figure 3-③), so the annotator always checked the original sentences. As we mentioned in the Section II, each opinion posted first in each thread contains subtitles in the "Title" section, (Figure 3-④). Subtitles are also annotated as one of the elements.

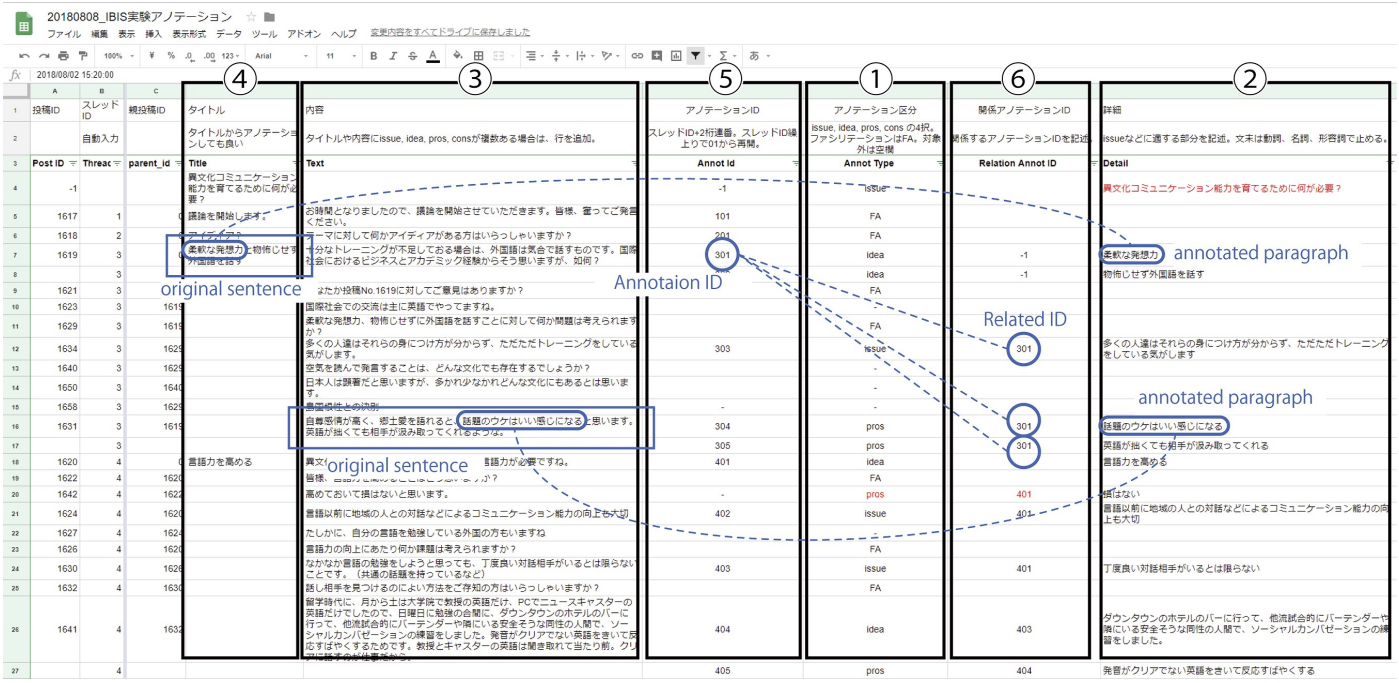

Figure 3. The Online Discussion data sheet annotated with IBIS elements

We put “Annotation ID” and “Related ID” on all annotated phrases to make the annotation process smarter and to think about data usability. In (Figure 3- ⑤, ⑥), “Annotation ID” is the number of annotated phrases for identifying each piece of data, and “Related ID” shows which direction the phrases (opinions) were posed in to other phrases. After the preparation process from i) to v) above, the discussion data was shared with annotators on a Google spreadsheet so that annotators could coordinate annotation procedures with other annotators. Once they finished annotating all the posted opinions, an examiner checked all of the annotation results. That is the complete process for processing discussion data.

TABLE I. THE AVERAGE PERCENTAGES OF EACH ELEMENT

FA	ISSUE	IDEA	PROS	CONS	N/A
14.23%	14.88%	31.77%	18.05%	14.74%	6.32%

TABLE II. THE AVERAGE NUMBERS OF IBIS ELEMENTS EXTRACTED BY FACILITATORS

ISSUE	IDEA	PROS	CONS
1.64	2.06	1.17	1.22

B. Examination of the processed discussion data

From the processed data, we examined the possibility of a discussion design constructed by IBIS ideas. For that data, we focused on the percentages of IBIS elements in all of the opinions shared. We assumed that the discussions were successfully facilitated in the point of high percentages of IBIS elements. Table I shows the average percentages of IBIS elements in our experiments. Another interesting result of these experiments is the average number of IBIS elements being extracted by facilitators’ lead. Table II shows its results.

The results in Table I indicate the possibility of discussion design based on IBIS structures even in online discussions. The percentage of N/A is quite low. It means we can extract IBIS elements from participants’ opinions in online discussions.

This is an important factor for the research and development of our automated facilitation system, because if we can classify all the opinions to elements, we could make discussion structures by making their relationships clear. Then we can get training data to develop an automated facilitators’ program. However, we have to consider the quality of the training data. There are so many possibilities when choosing training data, but it is necessary to pick something reasonable. We need some data which are obviously classified and capable of making structure. Thus, data classified by an IBIS are appropriate training dataset for deep learning for our system.

In Table II, each number was calculated by A/B, where A= (The total numbers of extracted each elements) and B= (The total number of facilitation postings which were intended to extract specific elements). We could successfully extract opinions with IBIS elements from the participants. If there had been less than 1, the method would have been considered a failure. However, the averages of each element extracted by

facilitators was different; the average number of Ideas was almost twice that of Pros. Improving our method is our future study.

V. Conclusion

We conducted an online discussion design experimental method for developing a large-scale consensus support system by implementing dialogue mapping and the IBIS structuring idea in our original online discussion system, D-Agree. Our experiments proved that it is possible to extract IBIS elements in non-framed online discussions. We also processed the discussion data to annotate each paragraph into IBIS elements. The annotated data can be used to develop the automated facilitator systems.

Our experiments led to our future work improving online discussion design. Our future work is fourfold: (1) Reveal the difference between discussions with/without a facilitator by analyzing the data quantitatively to see how many IBIS elements are present in each discussion. In the experiments in this paper, facilitators led all of the discussions with a dialogue mapping technique, and the effect of their facilitation was qualitative. (2) Collect more precise data and use a trusted method of judging annotation, like the Kappa statistic method. In this paper, we annotated IBIS elements for each discussion with multiple annotators, and completed a final check with another annotator. (3) Research other discussion design techniques. We need to compare other discussion design techniques to confirm the quality of the dialogue mapping technique. [7] [8] [9] We assume that the quality of both discussion data and the automated-facilitator system will be enriched after completing our future work. (4) Consideration for the way to consensus. The research in this time is one of the process of the development for large-scale consensus support system. Before thinking about integration of all the opinion, it is necessary to gather constructive ideas from all the participants. We propose one method for that process. Integration opinions and lead to consensus is one of our future works.

The discussion design is necessary for developing a large-scale consensus support system, which is the intended outcome of all our research. In our system, we will employ an automated-facilitator system. For its development, it is necessary to obtain defined data from well-designed discussions. Applying IBIS idea for discussion design is one of the effective ways for obtain defined discussion data. The idea of dialogue mapping fit into our demand－the idea which makes structures in a discussion. Because of the IBIS structures that made discussion classification possible. Several researchers recognize the effectiveness of dialogue mapping in discussion design and decision making, but we will investigate other discussion design and continue conducting online discussion experiments to improve discussion quality and make versatile discussion data.

Acknowledgment

This work was supported by the JST CREST fund (Grant Number: JPMJCR 15E1), Japan. I would like to thank all project members and related people for their contribution in the studies and the experiments.

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