

Extracting Agent-based Models for Considering Cultural Factors using Multilingual Case Method System

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ABSTRACT

Globalization has resulted in the need for businesspeople to have a global perspective. Various organizations are actively promoting the development of educational institutions to create diverse classrooms as an effective environment for the helping students to become global businesspeople. Recently, online educational environment has gained significant attention in the information technology development. Educational institutions all over the world have gained increasing research interest in Massive Open Online Courses (MOOCs), and these courses are described as an effective solution for problems associated with student diversity. In this study, we extract agent models based on cultural characteristics to construct an environment that simulates the student diversity. We conducted participatory case study experiments and achieved state transition diagrams that are related to the characteristics of each nationality. Finally, we analyzed their differences and similarities. By comparing the experimental results of culturally different participants, we found that we could extract differences of protocol patterns among the participant groups: American, South Korean, and Japanese. We determined the possibility of creating cultural related player agents by the application of cultural differences that we identified as important for the protocol description required for constructing agent-based models.

KEYWORDS

multilingual case study system; multicultural collaboration; cultural diversity; online educational environment; agent-based models;

1 INTRODUCTION

Owing to the increase in globalization, businesspeople now need to have a global perspective. Various organizations actively promote the education of global human resources and the internationalization in Japan. In addition, international collaboration between universities has resulted in more foreign students studying in

Japan. Therefore, in the various educational fields that include case studies, students are expected to gain new knowledge through the synergistic effect achieved by teams comprising members from different cultures or nationalities [1].

However, students who are from different cultures and speak different languages need to overcome non-native language (common language in participants) communication and the lack of cross-cultural understanding to accomplish mutual understanding. Language and culture cannot be represented by the statement “If it differs in the speaker’s culture, it differs not only in terms of the content, but also in the manner in which it is said” [2][3]. According to Omi [2], it is necessary to understand the different thinking patterns and the differences in perception. Further, a culture cannot be understood or inherited unless it is experienced. In fact, for global human resource education, we need to understand and experience other cultures through methods such as communication.

Our research goal is to extract agent-based models by considering cultural factors to create an environment that can be used to easily experience cross-cultural aspects. Thus, we extract behavior models through participatory experiments and analyze the characteristics of each nationality. Then, we construct state transition diagrams for agent-based models. An agent-based model is a class of computational models used to simulate the actions and interactions of autonomous agents for assessing their effects on the system as a whole. Agent-based models consist of dynamically interacting rule-based agents. The systems within which they interact can create real-world-like complexity. State transition diagrams allow the easy construction of classroom diversity based on the extracted agent-based models. In addition, agents can autonomously determine their behavior while interacting with the class environment and other agents. Multiagent diverse classrooms represent individual decision-making in detail according to each agent’s circumstances and reproduce complex phenomena that arise from case discussions between different agents, which is an educational benefit for

the participants[4].

2 PROPOSED APPROACH

The case method is a teaching approach that consists of presenting the students with a case and placing them in the role of a decision maker facing a problem [5]. Presently, students that access the Internet participate in online courses, and take classes and discuss case studies with other students. However, case materials used in MBA programs are mainly written in English. Therefore, the students are required to be to understand and speak fluent English along with their native languages. Therefore, it is difficult for students who are non-native English speakers to read and participate in case discussions. In general, non-native English speakers need to improve their English skills to participate in MBA programs for a few years of study abroad. The language classes that need to be attended out of necessity are expensive for the students. Therefore, to avoid this additional expenditure, it is necessary to resolve this issue.

In this study, we prepared an online class environment in which students can participate in the case method using their own native language. In this system, students from many different countries speak with other participants and discuss case materials with respect to different cultural backgrounds. This class can overcome the linguistic barrier at some level and enable students to easily participate in cross-cultural discussions. The left-hand side of Fig. 1 describes a recent online class style in which students from different countries attend the class at a particular time and participate in case discussions. However, it is practically difficult for students to attend a class at a particular time owing to physical barriers such as time differences. Therefore, the case method in a diverse environment is hampered by physical barriers. Our proposed approach can easily maintain a diverse environment by overcoming the abovementioned barriers (Fig. 1). The right-hand side of Fig. 1 describes replacement participants as agents. We adopt an agent that considers cultural factors instead of participants that have different cultural backgrounds. Agents that consider each cultural characteristic such as thinking and behavioral mannerisms participate in the discussions. The system provides an educational environment that students can use without the influence of time differences. However, to design these agents, we need to design a large cultural variety of agents. We can create an environment consisting of a variety of (virtual) students by preparing diverse agents by simulating the case study class in the real world. In particular, in the case of dealing with cultural problems in business, this system produces the effect expected in the above environment with a high accuracy. Therefore, we collect the student’s behavior model through actual discussions about business case materials. Then, we extract the agent model to create a

student agent that considers cultural characteristics for each nationality.

2.1 Extraction Procedure

We extract agent models as per the method stated in [4]. To obtain cultural characteristics related to a agent model, we conduct a simulated case method for use in an actual education field, and collect the discussion logs.

We apply the results of the analysis of discussion logs to protocol analysis to reveal the process of communication for all participating nationalities. First, we conduct a simulated case study using participants from different nationalities using the multilingual case system, which is explained in Section 3.1. Next, we collect discussion logs that is derived from each nationality’s participants using real case discussions. Finally, we assign utterance tags to the discussion logs for extracting agent models (Fig.2).

The tags used in Fig. 2 are summarized in Table 1. We divide the discussion logs into short topics and assign utterance tags on the basis of utterance types (Table 1) to each utterance using the method proposed by Wang et al. [6] for discussion logs.

Table 1: Utterance types (Tags)

Type	Definition
Opinion	Own opinion about case material
Agree/Disagree	Agreement/disagreement with other participants
Question	Utterance asking for feedback
Explanation	Supplemental explanation about own opinion
Procedure	Mainly facilitator’s utterance
Other	Unclassifiable utterance

We observe the condition of each participant using tag information and extract some states. Similarly, we extract utterance types that change from their current state to the next state. Finally, we tally the data described above.

Further, we construct a state transition diagram using the method proposed by Torii et al. [7] in which the discussion logs are divided into minimum discussion topics. We also analyze the behavioral tendencies of each participating nationalities. Finally, we extract agent-based models considering the cultural factors through the application of the above data counted for each nationally based on protocol description.

3 EXPERIMENT

We conducted a participatory experiment in which we applied our simulated case method [8]. We conducted the experiment in accordance with the process of the case method. First, each participant logged in, selected their native language, and read the case mate-

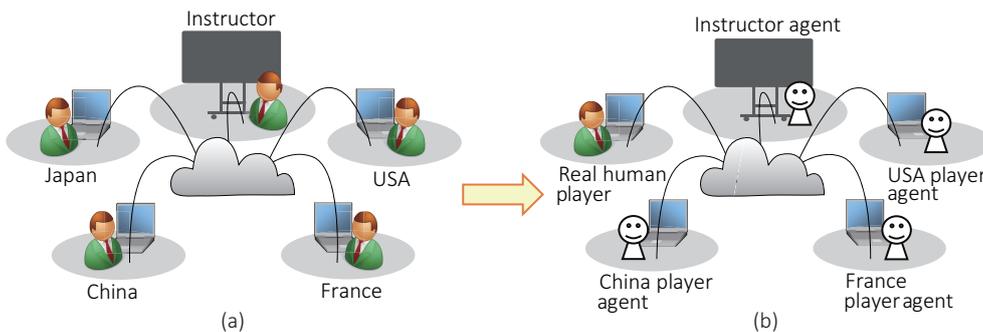


Figure 1: Class images: (a) recent style and (b) proposed style

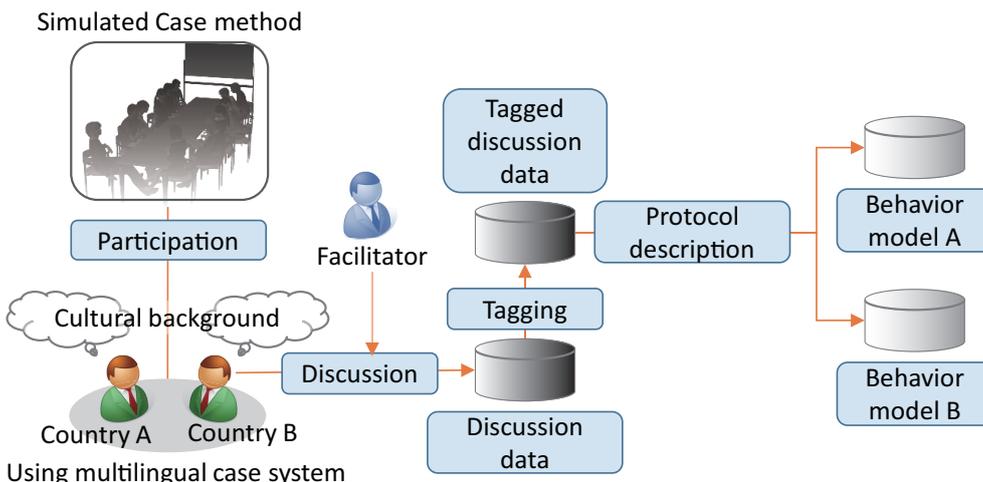


Figure 2: Procedure for the extraction of an agent model

rials shown on the Web. The selected case was described in their native language. Next, they chose a sentence in the case content and noted it with a line number and case passage using analysis notes for organizing information. The participants then estimated the meaning of the sentence by back-translation, although they worked in their own language. Participants’ analysis notes are stored in the shared analysis note database. Then, the participants discussed the problems in the case using multilingual chat. Text messages were stored in the Chat database. After the case discussion, we conducted a questionnaire regarding the participant’s opinion about each nationality, mistranslations, this system, and the case method. We conducted cross-cultural analysis using the discussion logs. We applied the discussion logs recorded dynamically during the process of interactive communication between the participants to analyze the thinking processes and behavior.

3.1 Experiment System

Figure 3 shows the configuration of the system used in the experiment. This system [9] was developed on a cloud-based computing environment and was connected to the Language Grid [10]. We used the “multilingual studio” [11], which is a set of application

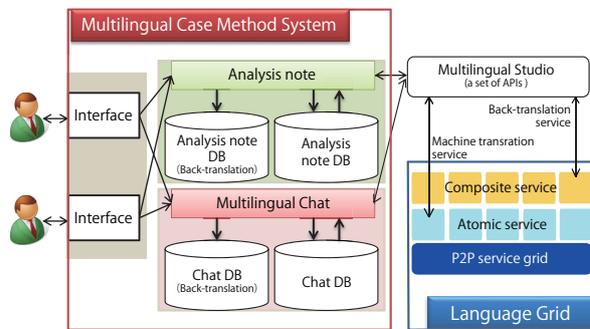


Figure 3: System configuration

programming interfaces (APIs) for using the multilingual Web services, which are language sources (e.g., machine translation and dictionaries), provided by the Language Grid. We can shift between more than 170 language services (e.g., French, Vietnamese, and so on) by changing the language service API based on the case language.

3.2 Participants

Eight pairs of university students belonging to the United States, South Korea, and Japan participated in the experiment (six Japanese speakers from Japan, six

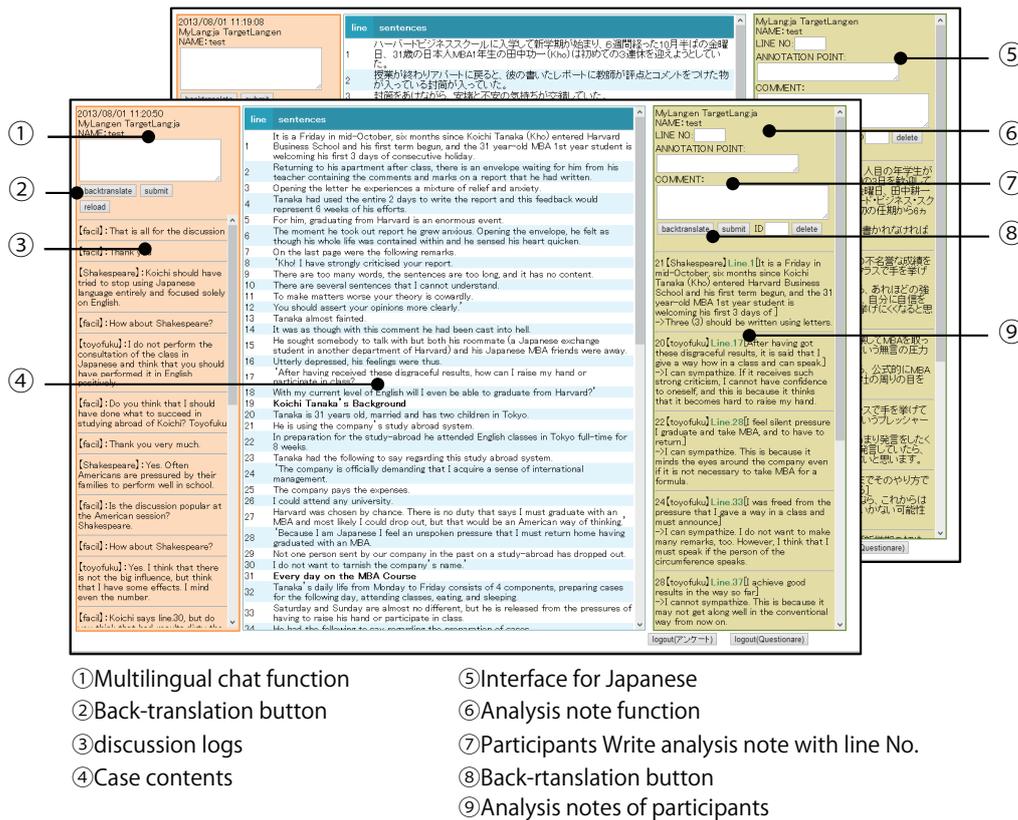


Figure 4: Application interface (The bottom-left is an interface for American English and the top-right for Japanese)

South Korean speakers from South Korean, and four English speakers from the United States). We conducted experiments using three pairs of two Japanese students (six Japanese students), three pairs of two South Korean students (six South Korean students) and two pairs of two American students (four American students). Meanwhile, a Japanese national acted as a facilitator in the experimentation. This experiment plan was based on Yamashita's experiment plan [12]. Her experiments were conducted using six pair of students, and she analyzed the conversation data using the conversation log. Using the same conditions as her experiments, we conducted the experiments using Machine Translation(MT)-mediated case discussion experiments.

4 RESULT

The number of discussion logs obtained through experiment is as follows: American students have 63 discussion logs, Japanese have 136 discussion logs, and South Korean have 122 discussion logs. We show the example of tagging discussion logs and state transition of participants in Fig. 5.

The obtained state transition process is as follows: Participants transit to state A(Information arrangement) in which a participant gives his/her own opinion at the facilitators direction. If a participant cannot understand the meaning of a facilitators direction or

the other participants utterance (because of mistranslation), the participant requests an explanation and transits to state C(Waiting for explanation). When a participant wishes to know the other participants opinion, he/she transits to state B(Waiting for other opinion by asking a question).

We recognized four patterns of opinion-making behavior.

1. opinions stated after a facilitators direction
2. opinions that agree/disagree with other stated opinions
3. opinions that answer a question
4. opinions that explain or additionally supplement one's own opinion

Behavior patterns 1, 2, and 3 reveal one's own opinion. On the other hand, we also find instances of pattern 4.

Moreover, the flow of discussion begins to disrupt after references are passed to each other. Then, the participants scent discussion get stacked up and transit to state D (Waiting for facilitators direction). If a facilitator finds a point of discussion that needs to be explained and informs the participants to do so, they transit to Information arrangement again and discuss the point. If not, the topic is closed and the facilitator introduces a new topic.

Name	Utterance	Tag	State transition	
			Now	Next
facili	Then, do you think that there is a relationship to speak of in class and report to Lowest Score?	Procedure	Start	
1	I get the impression that he was the only foreign student in the class, so understandably his score would be the lowest.	Opinion	A	A
2	No because there may be some people who are shy in class and understand what the teacher is saying. If not student isnt willing to speak up because the person doesnt understand the material, then yes there is a relationship between the two.	Opinion	A	A
1	But speaking up in class does help you tell if you are on the right track and thus helps you produce better results on any assignment.	Agree/Disagree	A	A
2	Thats true. But if the person is too shy to speak in class, the person could always go to the teachers office hours or research it himself.	Agree/Disagree	A	A
2	Or.. What Im saying is there are shy people in class who dont speak up but can get good grades.	Explanation	A	A
1	Thats true. I think, in other words, its not about how much you speak up. Its about comprehension. Koichis comprehension was low. That is all.	Agree/Disagree	A	D
2	Yeah, I agree.	Agree/Disagree	A	D
facili	Do you think results and remarks in the classroom that are	Question	turn to A	
1	Not that much. I think its more of a relation between what he wrote on the paper and the results.	Opinion	A	A
1	After all, he only spent 2 days on it.	Explanation	A	D
2	In the case of Koichi, if he did speak up in the classroom, it may not have been beneficial to him. He didnt have a thorough grasp of English to begin with, so his lack of the language was what led him to his bad results.	Opinion	A	D

Figure 5: Example of the discussion log, tagging, and state transition

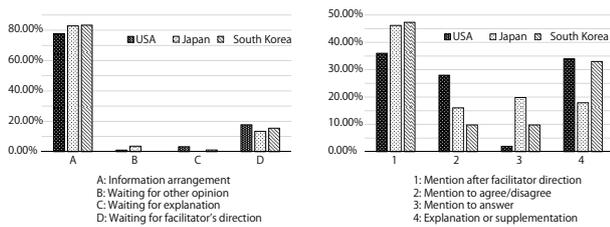


Figure 6: Ratio of state (left) and mention type (right) for every nationality

The counted number of appearance of each state for each participant along with each utterance type is listed in Table 2.

The left-hand side of Fig. 6 shows the ratio of states (A-D in Fig. 7), the right-hand side of Fig. 6 shows the ratio of transition patterns from Information arrangement (1-4 in Fig. 7). In the state graph, state A is the highest of all states for every nationality, followed by D, B, and C. Thus, we found no noted difference. Therefore, conceivably, no cultural difference exists in the ratio of these states. On the other hand, we found a significant difference (chi-square test; $p < .01$) in ratio of the utterance types (left-hand side of Fig. 6). Utterance types 1 and 4 are active utterances [6] that are opinions that wrap around oneself. Utterance type 2 and 3 are reactive utterances [6] that represent opinions for other's opinions or ideas.

Figure 7 shows a state transition diagram from discussion logs obtained in the experiment. In the figure, the top-left denotes the original transition diagram; the

top-right, Japanese; the bottom-left, American; and bottom-right, South Korean. The utterance types from state A in each nationality's state transition diagram reflects cultural characteristics. After counting the ratio of appearances, these lines imply the following: $x < 15\%$: thin line, $15\% \leq x < 30\%$: medium line and $30\% \leq x$: heavy line.

In the case that utterances 2 and 3 have a large appearance, it is possible to regard the nationality as interactive. Americans have a low number of utterance 1; however, the number of utterance 2 is the largest compared to other nationalities. On the other hand, utterance 3 is extremely low for Americans. For the Japanese, we identified that the number of utterance 3 are the largest compared to others. This implies that the Japanese participants constantly explored the same opinion interactively. It would appear that the Japanese tend to say if they agree or disagree after listening to other participants. For the South Korean participants, utterances 1 and 4 account for 80% of all discussions. Thus, South Korean participants are thought to have a less tendency to interact while in a discussion.

5 DISCUSSION

We noted some differences and similarities in the results of the protocol analysis. The Japanese had a high propensity for listening carefully to other participants' points of view. Moreover, the Japanese participants responded to others' opinions and respected their point of view. On the other hand, South Korean partici-

Table 2: Number of state and mention type for every participant

Participant	A	B	C	D	Total	1	2	3	4	Total
American 1	10	0	0	4	14	3	1	1	1	6
American 2	12	0	0	4	16	3	1	0	4	8
American 3	23	1	1	4	29	4	6	0	7	17
American 4	25	0	2	4	31	8	6	0	5	19
Total	70	1	3	16	90	18	14	1	17	50
Japanese 1	30	2	0	2	34	11	4	4	6	25
Japanese 2	28	3	0	4	35	9	4	5	2	20
Japanese 3	27	0	0	5	32	7	4	7	4	22
Japanese 4	29	1	0	5	35	13	2	4	4	23
Japanese 5	10	0	0	3	13	4	2	0	1	7
Japanese 6	12	0	0	3	15	5	1	1	2	9
Total	136	6	0	22	164	49	17	21	19	106
South Korean 1	33	0	0	5	38	13	1	3	11	28
South Korean 2	29	0	0	5	24	11	3	4	6	24
South Korean 3	12	0	0	3	15	5	1	0	3	9
South Korean 4	14	0	0	3	17	8	1	1	1	11
South Korean 5	24	0	0	5	29	9	1	2	7	19
South Korean 6	28	0	2	5	35	7	4	1	9	21
Total	140	0	2	26	168	53	11	11	37	112

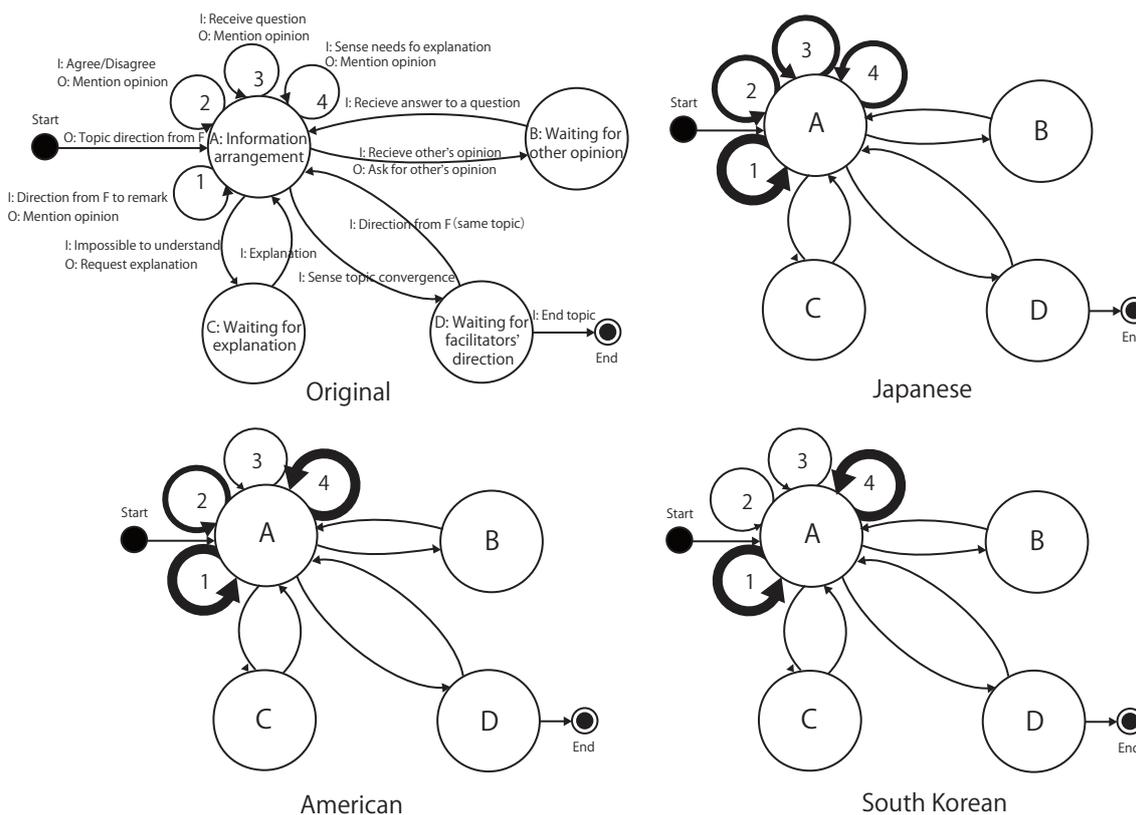


Figure 7: Transition diagram: original, Japanese, American, and South Korean

Participants tended to push their opinions more strongly to convince other participants. Further, the Americans tended to argue strongly for their own opinions. However, although they considered other opinions, they tended to disagree with them.

In MT-mediated communication, it is necessary to consider mistranslations. We found a discussion on mistranslation in state C (Waiting for explanation) in the experiment with Japanese and South Korean participants. A facilitator noticed a particular miscommu-

nication between a South Korean and Japanese pair. This facilitator asked the Japanese participant to write in a more understandable manner for the South Korean participant. The South Korean participant understood the message and answered as per the requirement of the Japanese participant. Thus, this helped in overcoming the mistranslation. Therefore, we identified the possibility that third-party support can overcome mistranslations.

We conducted a questionnaire about the amount of mistranslation (scale of one to ten) and communication (five levels: Communicated very smoothly, Communicated satisfactorily, Communicated somehow, Communicated with difficulty, Could not communicate.). According to results of the questionnaire, most participants felt that mistranslation accounted for 21% to 30% of the messages. However, most participants answered “communicated satisfactorily” and “communicated somewhat.” Moreover, the “Could not communicate” option was not selected by any participant. In this study, we could not identify the dissonance caused by mistranslation.

6 RELATED WORKS

Since global businesses and organizations increasingly bring people together from around the world to solve common problems [13][14][15], challenges due to linguistic differences occur. Similarly, in the educational context, problems arise from differences in communication styles, relationship norms, negotiation strategies, and methods of dealing with conflict [16]. To solve these problems, the case method was conducted in various educational institutions. The case method was developed in the early 20th century by the Harvard Business School in the United States [8]. Case materials used in MBA programs are mainly written in English, and therefore, it is difficult for students who are non-native English speakers to read and participate in case discussions. Therefore, participants are limited to those who can speak fluent English. There are many business students who attend case discussions using OpenCourseWare even if they cannot speak English.

Recently, the Massive Open Online Course (MOOC)[17] is receiving significant attention. A MOOC is an online course with the option of free and open registration, a publicity-shared curriculum, and open-ended outcomes. A MOOC facilitates the participation of an acknowledged expert in a field of study, and a collection of freely accessible online resources. In addition, it builds on the active engagement of several hundred to several thousand “students” who self-organize their participation according to their learning goals, prior knowledge and skills, and common interests. In general, an MOOC has no fees, no prerequisites other than Internet access and interest, no pre-defined expectations for participation, and no formal accreditation.

This paper aims to extract agent-based models for students with diverse values and cultural differences. The agent-based models will be available for the case discussion class on the MOOC.

7 CONCLUSION

In this study, we proposed a procedure of extracting agent-based models considering cultural factors, and we extracted agent-based models from actual communication logs by following the proposed process. We conducted a small experiment for three nationalities in this study. On conducting participatory experimentation, we found that the utterance behavior model in a chat discussion can be distilled into a state transition diagram. However, we believe that it is possible to create a player agent that behaves more specific to a particular country. Therefore, we need to extract new characteristics and differences more finely by increasing the number of participants and nationalities.

As our future work, we plan to implement the extracted agent-based models as agents, and conduct experiment by the application of conversation systems using the text corpus.

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