Neclle: Network-based Communicative Language-Learning Environment Focusing on Communicative Gaps

Hiroaki Ogata, Yuqin Liu, Youji Ochi, and Yoneo Yano
Department of Information Science and Intelligent Systems, Tokushima University
2-1 Minamijosanjima-cho, Tokushima, 770-8506, Japan
Tel: +81-88-656-7498   Fax: +81-88-623-2761
E-mail: ogata@ is.tokushima-u.ac.jp
URL: http://www-yano.is.tokushima-u.ac.jp/ogata/

Abstract: This paper focuses on the problem of language transfer in foreign language learning. The transfer often leads to a communicative gap, which is caused by the difference between a learner's mother language (ML) and the target language (TL). This paper first analyzes the semantic relations between the ML and the TL. Then it proposes a CGM (Communicative Gap Model) because of the meaning difference between both languages. We have developed a computer assisted language-learning system called Neclle (Network-based Communicative Language-Learning Environment) in order to support foreign language learning through communication using a text based chat tool. Neclle has a software agent called Ankle (Agent for Kanji Learning), which observes the conversation between a learner and a native speaker, looks up a communicative gap in the learner's utterance automatically according to CGM, the student model and the word dictionary of both languages, intervenes into the conversation, and gives an instruction for bridging the gap. Then, the learner can not only be aware of the gap but also acquire its cultural background from the native speaker. In our case study, Chinese students used Neclle for Japanese language learning. Japanese language had incorporated with Chinese kanji but the meaning of a kanji sometimes differed between two languages. Therefore, the Chinese learners who want to study Japanese language have to pay much attention to the meaning gap between Chinese and Japanese language. In the evaluation of Neclle, nine Chinese students talked with Japanese students about three topics with Neclle for one hour and half. The results of the experiment showed that it was very useful for Japanese language learning.

Keywords: computer assisted language learning, agent-mediated communication, communicative approach, cross-linguistic influence, language transfer, and Japanese language learning for Chinese students.

1. Introduction

With the fast development of the Internet, people around the world have more chances to communicate directly with CMC (Computer Mediated Communication) tools, such as e-mail, a chat tool and a bulletin board system. In CALL (Computer Assisted Language Learning), researchers have recently attracted much interest to language learning based on CMC. That is because it is possible for a learner to communicate with a native speaker using a CMC tool in a target language that the learner wants to learn. The

approach that emphasizes the language learning through communication is called "communicative approach" (Johnson & Morrow, 1981; Okazaki & Okazaki, 1989). This approach is one of language-learning methods, which gives emphasis to communication primarily, and grammatical rules and vocabularies are of secondary importance. In fact, many approaches, which are intended to facilitate exchange of cultures and language learning with a CMC tool, have been proposed (Hanson, 1998; St. Olaf College, 1992; Saita. et al, 1996).

Hanson et al. (1998) used a CMC tool for enhancing international cooperation and comprehension among students in the world. Through the experiment, the learner's ability to comprehend and express himself/herself in foreign language has been highly improved. Saita et al (1996) examined the variation of wrong terms and corrected ones in the communication between learners and native speakers. They reported that the percentage of wrong terms gradually declined, learners came to use sentences with more complicated structure, and the learners' ability to use the language was highly improved. They also pointed out direct communication with native speakers was very important for foreign language learning. Therefore, this paper focuses on communicative approach for language learning using a chat tool as a CMC tool.

Cross-linguistic influences have also been identified as important factors influencing second language acquisition (Odlin, 1989). Language transfer means that one's mother language (ML) tends to influence learning a target language (TL), and it can have both negative and positive effects. If a transfer does not cause a communicative gap between the ML and the TL, it, called "positive transfer", facilitates language learning. On the other hand, if a transfer causes a gap, it is called a "negative transfer". Negative transfer (hereafter sited as a language transfer) is a serious problem in foreign language learning because of the gap between the ML and the TL (Lado, 1957; Odlin, 1989; Tanaka, 1989). Therefore, this paper proposes a CALL system focusing on communicative gaps that are caused by the meaning difference between Japanese and Chinese Kanji.

As for related researches, an intelligent CALL system called Mr.Collins (Bull, 1993; 1997) was developed. It focused on language transfer that was caused by the grammatical difference between a learner's ML and the TL. The system facilitated the acquisition of pronoun placement in Portuguese language learning. In addition, "Cross Talk" (Lavy, 1999) was a CALL environment based on cross-cultural pragmatics. It tackles the issues of pragmatic transfer in the conversation between a learner and a native speaker. However, there are few approaches focusing on communicative gaps based on the meaning differences in CALL.

This paper proposes an agent-mediated language-learning environment called Neclle (Network-based Communicative Language-Learning Environment) that focuses on the meaning difference between the learner's ML and the TL (Liu et al. 1999; Ochi et al. 1999; Ogata et al. 2000). In Neclle, a software agent, named Ankle (Agent for Kanji Learning), observes the conversation between a learner and a native speaker using a text based chat tool, and it automatically looks up a communicative gap in the real time conversation. If a communicative gap is found in the conversation, Ankle intervenes into it, and gives an instruction for bridging the gap. Then, the learner can not only be aware

of the communicative gap but also acquire its cultural background from the native speaker.

As for the case study of the framework of Neclle, this system supports Chinese people to learn Japanese language. Japanese language had incorporated with Chinese Kanji but the meaning of a Kanji sometimes differed between two languages. For example, "祖父" means the father of the father in Chinese, but it means the fathers of both the father and the mother in Japanese. In this case, the Japanese meaning of "祖父" includes its Chinese meaning. Ankle has the word dictionary of the different meaning, and detects the meaning difference according to the dictionary when the words that cause communicative gaps, such as "祖父", appears in the conversation. Therefore, Chinese learners who study Japanese language can be aware of the communication gap between Chinese and Japanese languages.

The rest of this paper is organized as follows. In section 2, we analyze the relation between the learner's ML and the TL, and describe a communicative gap model based on language difference. Section 3 presents a system framework and an agent oriented foreign language learning support. Section 4 shows the development of Neclle system focusing on the difference between Japanese and Chinese kanji meaning. Section 5 describes the experimental evaluation of Neclle. Finally, conclusions are drawn in section 6.

2 Language transfer and communication

Language transfer is the influence resulting from similarities and differences between the TL and any other language that has been previously (and perhaps imperfectly) acquired. The results of contrastive linguistics research (Wardhaugh, 1970) are very useful for predicting and preventing language transfer. In this section, first, we analyze the relation of vocabulary meaning between the learner's ML and the TL, referring to a contrastive linguistics theory. Because the transfer often leads to a communicative gap, this paper also proposes the communicative gap model based on the meaning relation.

2.1 Meaning relation between a ML and a TL
The research of contrastive linguistics has been carried out on the relation of vocabulary meanings between a ML and a TL. Andou (1986) classified the relation into three groups: (1)same, (2)overlap and (3)different. In this study, we furthermore subdivided the "(2)overlap" into "inclusion" and "overlap-different" from the point of view of foreign language learning. That is because it is very important for a learner to understand clearly whether the meaning of his/her ML covers that of the TL or not. Figure.1 shows some examples of the relationship between Japanese and another language.
(I) Same relation:
  Both of learner's ML and the TL have completely same meaning. For example, the meaning of "春 (haru)" in Japanese absolutely corresponds to that of "spring" in English.
(II) Inclusive relation:
  Narrow relation (IIa): The meaning scope of the ML is a subset of the TL's meaning. For example, "着る(kiru)" in Japanese means "to put the clothes on only

for clothes such as a coat or jacket", but not including clothes such as pants and skirt. So "着る(kiru)" belongs to (IIa). Broad relation (IIb): The meaning scope of the ML is broader than that of the TL. For example, "兄弟(kyodai)" in Japanese means not only "brothers" but also "sisters" in English. Therefore, "兄弟(kyodai)" belongs to (IIb).

(III) Overlap and different relation:

Although the ML and the TL have the same meanings, they also have different meaning. For instance, "単位(tan'i)" in Chinese means "unit", that is the same meaning as in Japanese. It also means "place of employment", but it has no meaning of "credit" like in Japanese. So, "単位(tan'i)" belongs to (III).

(IV) Different relation:

The meanings of the ML are completely different from that of the TL. For example, "鳥居(torii)" is a gateway at the entrance to a Shinto shrine, which is special of Japanese culture. Therefore, there is no word in any other language corresponding this word.
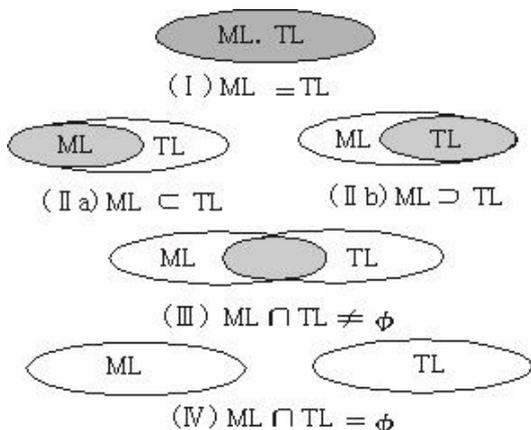
Relationship	Example (Japanese : another language)
(I)	春 : Spring (English)
(IIa)	着る : Put on (English)
(IIb)	兄弟 : Brother (English)
(III)	単位 : 単位 (Chinese)
(IV)	鳥居 : Nothing

ML: mother Language   TL: Target Language

Figure1: Meaning relation between mother language and target language.

2.2 CGM (Communicative gap Model)

Based on the above meaning relation, we have analyzed the factors of a communicative gap as follows:

(1) Different meaning between a learner's ML and the TL: A Learner may make misunderstanding of a word of the TL because of the difference between the ML and the TL (Odlin, 1989). If the meaning relationship is "(II) inclusive" or "(III) overlap and different", then a communicative gap often occurs to the learner.

(2) Learner's position in communication: There are two positions in communication. One is a "sender" and the other is a "receiver". Depending on a learner's position (a sender or a receiver), a communicative gap occurs to the learner. For example, a learner uses (sends) a word that has a narrow meaning in "(II) inclusive relation", a communicative gap may not occur to the leaner. That means the native speaker of the TL can understand the learner's word completely because the TL includes all the meanings of the ML. Inversely, if the learner receives a narrow-meaning word from a native speaker, a gap will occur to the learner.

(3) Same written form between the ML and the TL: This system provides a text-based communication. Therefore, a communicative gap may occur even with the same

written form. If the written form of the ML is different from that of the TL, there is no gap. If the ML's form is the same as the TL's form, a gap may occur. For example, "走" means "walking" in Chinese, but it means "running" in Japanese. Therefore, "走" may bring a gap to the learner.

Considering the three above factors, this paper proposes a CGM (<u>C</u>ommunicative <u>G</u>ap <u>M</u>odel) (see Table 1).
- In (I) same relation, there is no gap because the meanings of the ML and the TL are the same.
- In (IIa), when a learner is a receiver, the learner understands the TL's meaning as a narrower view than the TL. Therefore, a gap occurs to the learner. If the learner is a sender, a gap does not occur. The native speaker is able to understand what the learner means, because the meaning of the TL is wider than that of the ML.
- In (IIb), when the learner is a sender, a gap can occur. Namely, it is often difficult the learner to know the native speaker's understanding, because the native speaker may understand the learner's expression with a narrower scope than the learner's intention. On the other hand, if the learner receives the native speaker's utterance, no gap will occur to the learner.
- In (III), if a learner or a native speaker uses the word that means exclusive of the same meaning, a gap can occur to the receiver.
- In (IV), if the written form of the ML is different from the form of the TL, a gap will not occur. However, a gap can occur to both the sender and the receiver if the written forms of the ML and the TL are the same.

Table 1. Communication gap model.

Written form	Same		Different	
Position / Meaning relation	Receiver	Sender	Receiver	Sender
(I) ML = TL	×	×	×	×
(IIa) ML ⊂ TL	○	×	○	×
(IIb) ML ⊃ TL	×	○	×	○
(III) ML ∩ TL ≠ φ	○	○	○	○
(IV) ML ∩ TL = φ	○	○	×	×

○ : gap, × : no gap

3   Framework of a communicative language-learning environment

This section presents an agent-oriented framework for a CALL system that focuses on communicative gaps caused by the meaning difference between a learner's ML and the TL.

3.1 Design policies of the framework
The design policies of the framework are as follows:
(1) Communicative approach: Learner studies a TL through communication with a native speaker with a chat tool. A software agent watches the conversation and makes the learner aware of a communicative gap, but it does not intervene into the

conversation as frequently as possible, because of the policy of the communicative approach.

(2) Focusing on a communicative gap: The system supports the learner to acquire the knowledge based on a communicative gap that means the difference between the learner's ML and the TL.

(3) Learner-centered design: Because the conversation in this learning environment is based on the learners' curiosity, the learner's motivation can be kept high. The software agent imperceptibly supports language-learning according to the contents of the conversation and the state of the learner's understanding.

3.2 The role of the software agent

Based on the above design policies, this paper proposes the framework of an agent based language-learning environment as shown in figure 2:

Step 1: A software agent observes the conversation between a learner and a native speaker with a text-based chat tool.

Step 2: The agent analyzes the utterance at real time by comparing each word in the utterance with the word in the "dictionary of knowledge", and looks for the difference of the word's meaning between the learner's ML and the TL.

Step 3: If the meaning of the word in the ML is different from that in TL, the agent detects a communicative gap in the utterance according to the CGM in table 1.

Step 4: The agent recognizes whether the learner has already understood the gap referring to the student model.

Step 5: According to the intervention strategies, the agent decides whether the agent intervenes into the conversation. If the learner does not understand the gap, the agent asks the learner a question about the meaning of the word that can cause the gap.

Step 6: If the learner's answer is wrong, the agent gives instructions about the gap according to the teaching strategies.
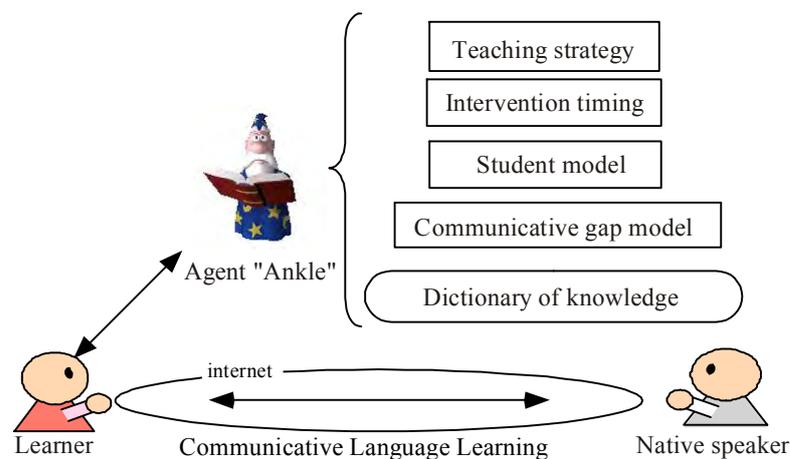

Figure 2. A framework of support language learning focusing on meaning difference.

3.3 Student model, intervention model, and teaching strategies

This paper focuses on a communicative approach and supports foreign language learning through communication with a native speaker. The design principles for the software agent in this framework are as follows:

(1) To avoid interrupting communication many times, the agent doesn't frequently intervene in the conversation.

(2) The agent gives the learner instructions for an adequate period, to avoid interrupting communication for a long period.

Based on the above principles, we propose the intervention strategies and the teaching strategies in this framework.
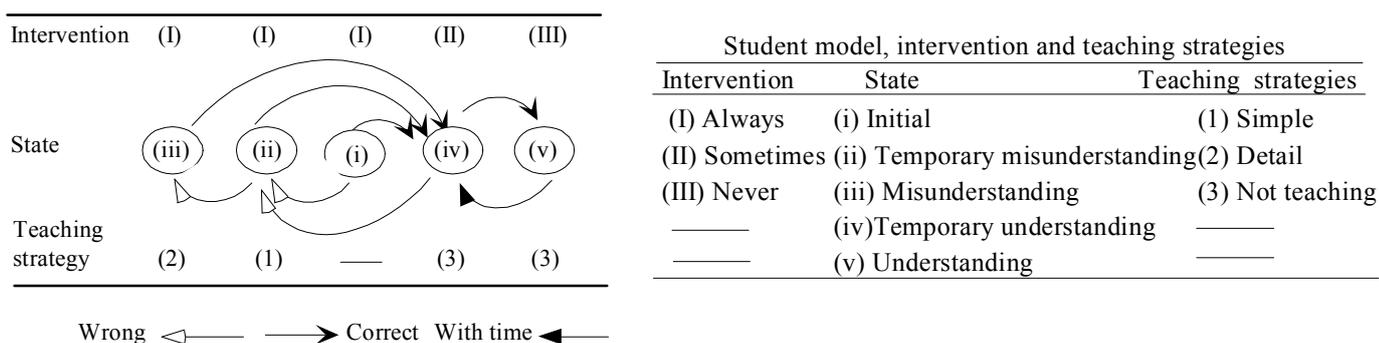

Student model, intervention and teaching strategies		
Intervention	State	Teaching strategies
(I) Always	(i) Initial	(1) Simple
(II) Sometimes	(ii) Temporary misunderstanding	(2) Detail
(III) Never	(iii) Misunderstanding	(3) Not teaching
———	(iv)Temporary understanding	———
———	(v) Understanding	———

Figure 3. Relation of intervention, student model and teaching strategies.

3.3.1 Student model

We have classified the state of the learner's understanding about the communicative gap into "understanding" and "misunderstanding". Moreover, those states are divided further into "temporary understanding" and "temporary misunderstanding." Those states change as shown in Figure 3. Each state (i) – (v) means as follows:

(i) Initial: Learner has not used the word that causes a communicative gap.

(ii) Temporary misunderstanding: Learner may not understand the gap.

(iii) Temporary understanding: Learner appreciates the gap provisionally.

(iv) Misunderstanding: Learner does not understand the gap at this moment.

(v) Understanding: Learner comprehends the gap correctly.

Each state will change according to the following rules. A state will move to the next state that is after the arrow, if the learner's answer is correct. (See Figure 3) If the answer is wrong, the state will shift to the next state written inside the < > symbols.

(i) -> (iv) <(ii)>:"Initial" moves to "temporary understanding," if the learner's answer was correct. Otherwise, it moves to "temporary misunderstanding".

(ii) -> (iv) <(iii)>: "Temporary misunderstanding" moves to "temporary understanding" if the learner's answer was right. Otherwise, it moves to "misunderstanding".

(iii) -> (iv) <(iii)>: "Misunderstanding" moves to "temporary understanding" if learner's answer was true. Otherwise, "misunderstanding" is continued.

(iv) -> (v) <(ii)>: "Temporary understanding" moves to "understanding" if learner's answer was right. Otherwise, it moves to "Temporary misunderstanding".

(v) -> (iv): The agent doesn't intervene in the conversation if the state is "understanding". However, "understanding" moves to "temporary understanding" with time

3.3.2 Intervention strategies
If there is any gap in the utterances, the software agent will intervene into the conversation, and give a question as following, according to the student's model.
(I) Always intervening: The agent always intervenes if the learner's state is "initial", "temporary misunderstanding", or "misunderstanding".
(II) Not always intervening: The agent sometimes intervenes, when the state is "temporary understanding".
(III) Never intervening: The agent does not intervene at all when the state is "understanding".

3.3.3 Teaching strategies
In order to avoid interrupting the communication for a long period, we have classified teaching strategies into "simple teaching" and "detailed one" (See Table 2).
(1) Simple teaching: The software agent just shows the relation diagram between the learner's ML and the TL, if the learner's state is "temporary misunderstanding ".
(2) Detailed teaching: The agent tutors exhaustive knowledge of the gap word in the TL, such as spelling, grammar, usage, etc., if the learner's state is "misunderstanding".

Table 2. Teaching strategy.

Simple teaching	Detailed teaching
Relation among the ML & TL	Relation among the ML & TL
Meaning of the TL	Meaning of the TL
————	Meaning of the ML
————	Relevant Knowledge of TL

4. Implementation of Neclle

We have developed a prototype system called Neclle (Network-based Communicative Language-Learning Environment), which focuses on the communicative gap caused by the meaning difference between Japanese and Chinese Kanji. Neclle has a software agent called Ankle (Agent for Kanji Learning). In this environment, a learner whose ML is Chinese learn Japanese Kanji through conversations with a Japanese native speaker. This section describes the implementation of Neclle and its user interfaces.
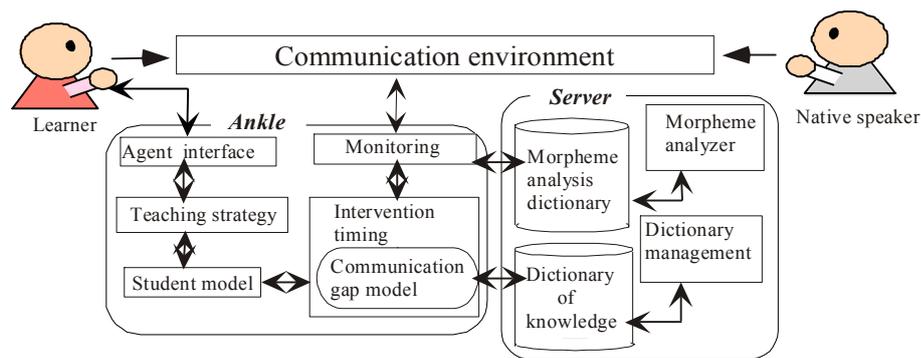
Figure 4. System configuration.

4.1 System architecture

Figure 4 shows the system architecture of Neclle system. Neclle consists of three modules: a communication tool, an Ankle agent, and a server. In Neclle, a learner communicates with a native speaker using a text-based chat tool.

4.1.1 Ankle

Ankle always stays in the learner's interface to support language learning. It is composed of the following modules:

(1) Monitoring module: This module records dialogues between the learner and the native speaker. It finds Kanji words in the conversation, and then determines whether these Kanji has different meaning between Japanese and Chinese, by referring the "dictionary of knowledge"

(2) Agent interface: The agent realizes humanoid software.

(3) Student model: This module manages the state of the learners' understanding, and the date of attendance.

(4) Intervention strategies: If Kanji word with a different meaning appears in the conversation, the agent looks for a communicative gap according to CGM, and then determines an intervention strategy for the query to the learner.

(5) Teaching strategies: If the learner's answer is wrong, the agent teaches the meaning of the word according to the teaching strategy.

4.1.2 Server

The server is composed of the following modules.

(1) Morpheme analyzer: This tool divides the utterance into Japanese morphemes. The results are sent to Ankle.

(2) Dictionary server: This dictionary includes the meaning of Kanji words in both Chinese and Japanese languages. After the morpheme analysis, Ankle compares the Japanese meaning of a morpheme with its meaning in Chinese, using the dictionary. If Ankle finds the word that will cause a communicative gap, Ankle teaches the learner the difference of the meanings in Chinese and Japanese languages.

4.2 Data representation

The data structure of the dictionary is shown in Figure 5. The data of Japanese words, such as meaning, grammar, and examples, are explained in Chinese. The data table of Japanese meaning is linked to the Chinese-meaning table and the Japanese-example table

with the field of "Kanji" and "Japanese". According to Bunkacho (1978), Tobita & Ro (1987), 403 Kanji words are recorded into the dictionary, which have different meaning between Japanese and Chinese languages.
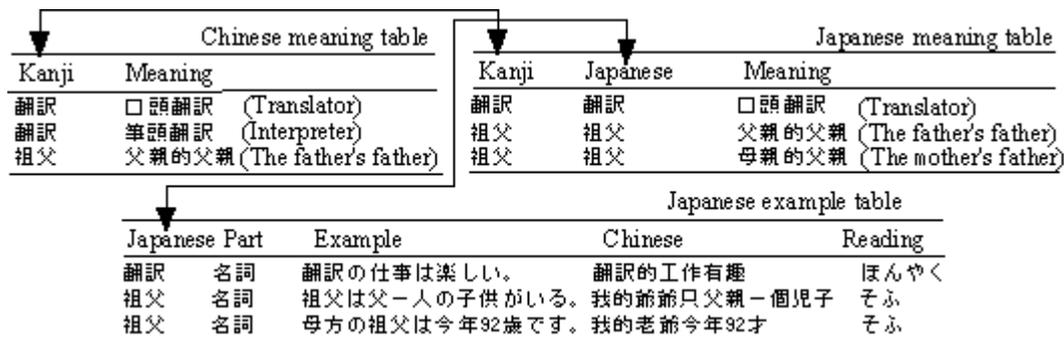

Figure 5. Data representation of the dictionary.

4.3 User interface

The user interface of Neclle is shown in Figure 6. It has five windows: "chat", "Ankle", "question", "teaching" and "dictionary".

(a) Chat window: Chinese learner whose name is "Yu" can engage in a real time communication with Japanese native speaker whose name is "Mori", using the chat tool. They told, in Japanese, about a major (subject) at the same University. Their conversation in the chat window (figure 6 (a)) can be translated into the following English sentences:

> YU: Hi. I'm yu. Are you ready?
> MORI: Ok. Let us talk about our study! What's your major?
> YU: My major is Japanese literature.
> MORI: Are you interested in Japanese language?
> YU: Yes. I want to be a Japanese translator (翻訳).

"翻訳" in Japanese means "translator" only. However, in Chinese, its meaning is not only "translator" but also "interpreter". Therefore, Japanese person might understand "翻訳" as "translator" only, although the Chinese learner means "翻訳" for "interpreter." Then, a communicative gap might occur to them.

(b) Agent window: Ankle has a personified interface, and it monitors the conversation. If a communicative gap occurs to the learner, Ankle tells the learner that in the message window as shown in figure 6 (b).
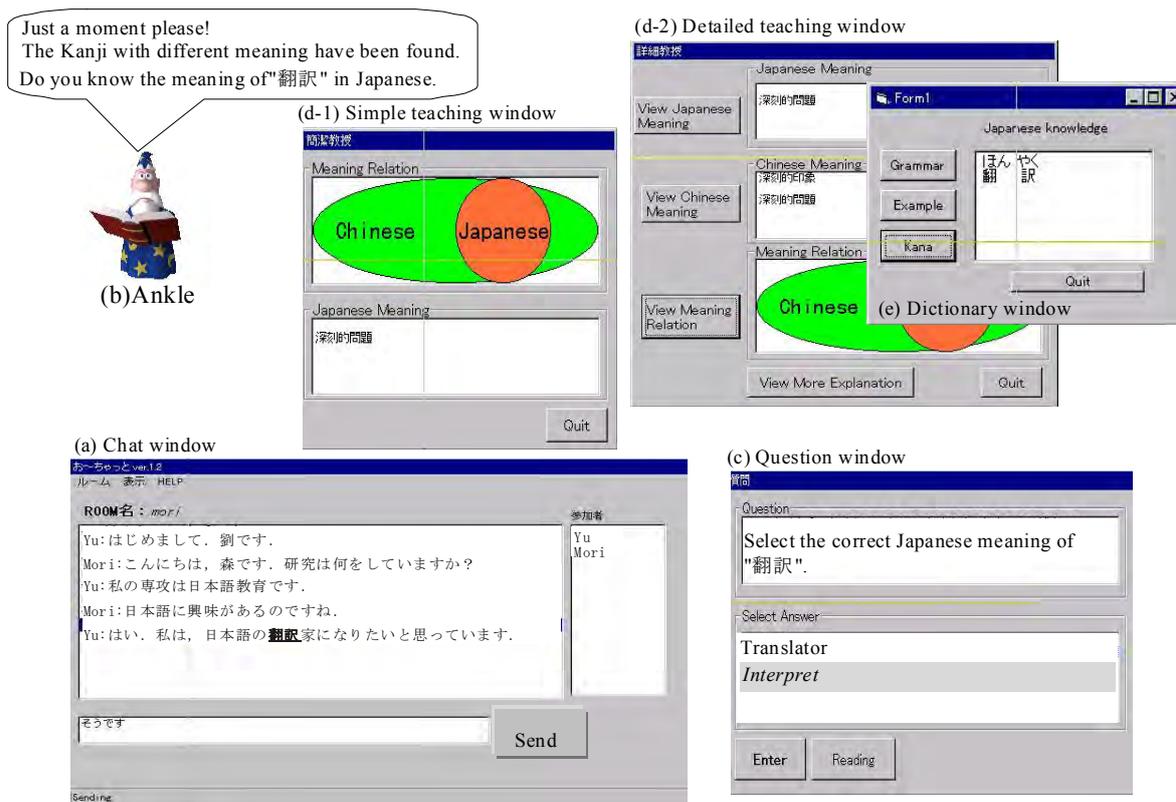
Figure 6. Screen snapshot of Neclle.

(c) Question window: Ankle asks the learner a question in the question window. The learner chooses an answer from a menu. Ankle verifies the answer, and informs the learner whether it is correct with a voice. For example, as for Japanese "翻訳(hon'yaku)", the answer is correct if the learner chooses "translator", and the conversation can continue without Ankle's intervention. However, it is not correct if learner chooses "interpreter". In this case, either window (d-1) or (d-2) appears for the instructions.

(d) Teaching window:

    (d-1) Simple teaching window: If the user's state is "temporary misunderstanding", Ankle gives instructions with a diagram of the meaning relation between Japanese and Chinese languages. When the learner clicks on a Japanese area, the window of Japanese meaning will appears.

    (d-2) Detailed teaching window: If the user's state is "misunderstanding", Ankle shows the detailed teaching window. If the learner requests to know more, a dictionary window will appear.

(e) Dictionary window: The detailed information on a word such as grammar, spelling, etc., is also provided in this window.

5 Experimental use

5.1 Method

We evaluated Neclle with nine Japanese students and nine Chinese students who consist of four beginners, three intermediates, and two advanced-level in Japanese language

learning. We arranged nine groups that consisted of one Japanese student and one Chinese student. Using Neclle they talked about three topics: "my family", "education in China", and "staying in Japan". Each pair had a conversation for at least 30 minutes about each topic. After three days, they talked again about the same topics with Neclle. Through this experiment, we investigated following items.

    (1) Validity of the intervention of Ankle.
    (2) Validity of the simple/detailed teaching by Ankle.
    (3) Learner's satisfaction with Neclle.
    (4) Effectiveness of Neclle for Japanese language learning.

Concerning to the above (1), (2), and (3), the learners gave ratings from 1 to 5 in each questionnaire, where five is the best and one is the worst. To evaluate "(4) the effectiveness of Neclle", we gave them an examination after this experimentation.

5. 2 Results

There were 878 sentences and 673 Kanji words in all their conversations. 268 words of 673 Kanji had different meanings in Chinese and Japanese. Ankle intervened 168 times in their conversations. However, Ankle did not intervene 100 times, because the learners had already understood the meaning of the words. Table 3 shows the results of the questionnaire.

Table 3. Results of questionnaires.

Question	Ave.
(1) Was the timing of the Ankle's intervention suitable for you?	4.3
(2) Was the simple/detail teaching from Ankle suitable for you?	4.1
(3) Were you satisfied with language learning using Neclle?	4.1

5.2.1 Validity of Ankle's intervention

Learners gave 4.3 points to the first question on average, which shows that most of them were satisfied with the intervention of Ankle. For example, there was a comment: "Ankle noticed and taught me when I did not completely understand the Japanese meaning of a Kanji word." Therefore, we think that Ankle's intervention was very appropriate to the learners.

5.2.2 Validity of Ankle's simple/detailed teaching strategies

Learners gave 4.1 points to the second question on average. The following comment were given: "it was very good that the teaching strategies was divided into simple teaching and detailed one. Because Chinese people uses Kanji words also, they were able to understand some Japanese Kanji meaning by simple teaching." This comment means that our approach, which divides into "simple teaching" and "detailed teaching", was appropriate for Kanji learning. In addition, there was the following comment: "I wanted to learn the difference concerning not only the meaning but also the grammar". Therefore, we will attempt to introduce the grammatical difference into Neclle in our future work.

5.2.3 Learner's satisfaction with Neclle

Learners gave 4.1 points to the third question on the average. We got the following

comments from some learners.
- Ankle was a good partner, and it made language-learning easier.
- It was very nice for me to learn Japanese with a Japanese person through communication.
- I was surprised that I had not been aware of the difference between Japanese and Chinese meaning of the same Kanji, and I could learn Japanese language easily.
- It was excellent that not only Japanese language but also Japanese culture could be learned.
- I understood it wrong that Chinese learners do not need to learn Japanese Kanji because those are very similar. However, I misunderstood the Japanese meaning of Kanji many times in the use of Neclle.
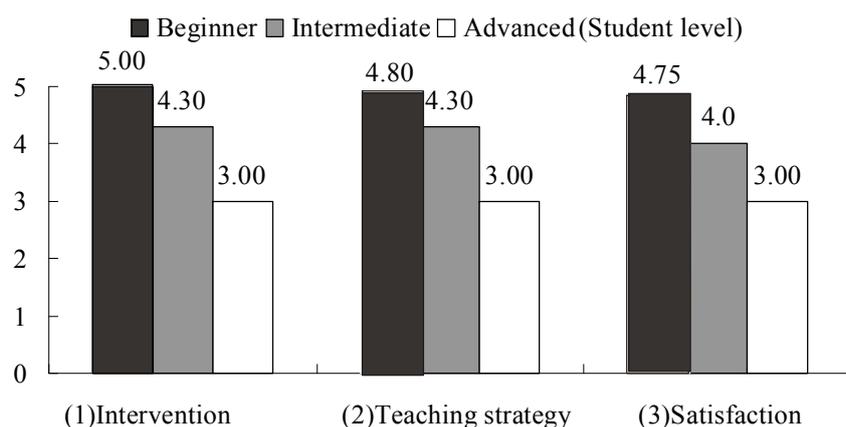

Figure 7. Relation between the learner's level and the average ratings.

Figure 7 shows the relation between the learner's level and the average ratings of the learners. The beginners gave the highest rating for each questionnaire. Therefore, Neclle is suitable for beginner learners. On the other hand, the advanced learners did not give high point. That is because Neclle often intervened to the advanced learners although they had understood the difference of most of Kanji words. Therefore, it would be necessary that the student model can be modified according to the Kanji words that the learner knows, before the leaner starts to use Neclle.

5.2.4 Effectiveness of Neclle for Japanese language learning
To evaluate the learners' understanding after the use of Neclle, we gave the learners the same questions again that Ankle had given to them. The examination was done at a short / long period after the system had been used. Figure 8 shows the results of the exams.

(1) Effectiveness at short period
Figure 8 (A) Shows the percentage of the correct answers that was gotten within one hour after the system was used. The learners correctly answered 82.9% of the Kanji meaning that had been taught through the simple teaching strategy, and 100% of the meaning that had been taught in detail. Therefore, the simple and detailed teaching seems

to be an effective approach.

(2) Effectiveness at long period
We examined the learners' understanding of the Kanji three days after using the system. The rate of the correct answers is shown in figure 8 (B). 80.4% of the questions by simple teaching were correct, which was slightly lower than that of experiment (1). The reason might be that the learners forgot some knowledge over the 3 days. On the other hand, the percentage of correctness after detailed teaching was 85.7%. This result means that our approach seems to be almost effective to keep learners' understanding.
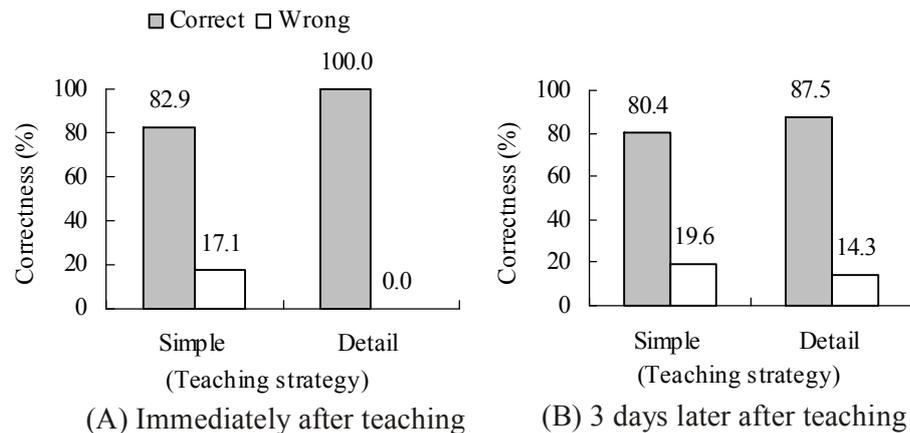
□ Correct □ Wrong

(A) Immediately after teaching   (B) 3 days later after teaching

Figure 8. Results of Kanji learning.

6. Conclusions and future work

This paper focuses on the problem of communicative gaps in foreign language learning, and analyzed the meaning relation between the learner's ML and the TL. We proposed a communicative gap model based on the meaning relation and developed a prototype system called Neclle where a leaner can learn the TL through communication with a native speaker. This paper also described a software agent that supports to bridge the communicative gap between the learner's ML and the native speaker's TL. Finally, we presented the development of Neclle, its agent Ankle, and showed the experimental use and the evaluation of Neclle made successes.

Neclle has been developed on Windows NT using Visual Basic 6.0 and Access 97. Chasen (Matumoto, et al, 1997) was a morpheme analyser of Japanese, and the Microsoft Agent (Microsoft Corporation, 1999) was used as our agent interface. In future work, firstly, we will improve Ankle more adaptive and adaptable to the learners' understanding, especially to advanced learners. Then, Ankle will be re-built for intervening into the conversation in a natural way, e.g, using voice technologies. Secondly, we will collect and add more data for the dictionary and keep on evaluating for a long time. Finally, we will try to apply Neclle to other languages, e.g., French and English.

References

Andou, S (1986). *The logic behind English and Japanese,* daisyukan, 28-37. (in Japanese)

Ayala, G. and Yano, Y. (1995) GRACILE: A Framework for Collaborative Intelligent Learning Environments, *Journal of Japanese Society for Artificial Intelligence*, Vo1.10, No.6, 988-1002.

Ayala, G. (1999) Modeling Software Agent for a Japanese Language Lifelong Learning Environment, *Proc. International Conference on Computer Processing of Oriental Languages* 99,509-514.

Bull, S. (1997) Promoting Effective Learning Strategy Use in CALL, *Computer Assisted Language Learning*, Vol.10, No.1, 3-39.

Bull, S., Pain, H.and Brna, P. (1993) Student Modeling in an Intelligent Computer Assisted Language Learning System: The Issues of Language Transfer and Learning Strategy, *Proc. International Conference on Computers in Education 93*, 121-126.

Bunkacho. (1978) *The Kango equivalent for Chinese*, research material of Japanese education, 85-143. (in Japanese)

Hanson, J., Ribold, M. and Weber, P., (1998) Cross Cultural Awareness, *Proc. World conference on Educational Multimedia, Hypermedia and Telecommunications 98*, 1900-1901.

Johnson, K. and Morrow, K. (1981) Communication in the classroom: applications and methods for a communication approach London: Longman.

Matumoto, Y., Kita, N., Yamashita, T., Hirano, Y., Ima, K. and Imamura, T., (1997). *System of Japanese morpheme analyzer – Chasen, Version1.0* (http://cactus.aist-nare.ac.jp/lab/nlt/chasen.html) (in Japanese)

Microsoft Corporation, (1999) *Microsoft Agent Documentation,* (http://msdn.microsoft.com/workshop/imedia/agent/documentation.asp)

Lado, R. (1957) *Linguistics across cultures: applied linguistics for language teachers*. Ann Arbor: Michigan University Press.

Levy, M. (1999) Theory and Design in a Multimedia CALL Project in Cross - Cultural Pragmatics, *Computer Assisted Language Learning*, Vol.12, No.1, 29-57.

Liu, Y., Ogata, H., Ochi, Y. and Yano, Y., (1999) Agent based Computer Supported Language Learning Environment focusing on Languages Distinction, *Proc. International Conference on Computer Processing of Oriental Languages 99,* 261-264.

Liu, Y., Ogata, H., Ochi, Y. and Yano, Y. (1999). Neckle: Network-based Communicative Kanji Learning Environment focusing on the Difference between Japanese and Chinese Kanji Meaning, *International Conference on Computers in Education*, Vol.2, 515-522.

Ochi, Y., Liu, Y., Ogata, H. and Yano, Y. (1999). Evaluation of Agent Intervene Model for Kanji Learning via Text based Communication, *International Conference on Computers in Education*, Vol.1, 126-132.

Odlin, T. (1989) *Language Transfer, Cross-Linguistic Influence in Language Learning,* Cambridge University Press.

Ogata, H., Liu, Y., Ochi, Y. and Yano, Y.: Agent Mediated Language-Learning Environment Based on Communicative Gaps, *Proceedings of International Conference on Intelligent Tutoring Systems*, (2000) (in press)

Okazaki, T., Okazaki, H. (1990) *Communicative approach in Japanese education*, Bonjinsya. (in Japanese)

Saita, I., Arruson, R., Itoman, D., Otubo, K., Mtuzaki, H., Kawazoe, Y. and Iguti, N. (1996) Designing Japanese Language Learning using Email, *Journal of Japanese Language Teaching Society*, 49-54 (in Japanese)

St. Olaf College, (1989.) Intercultural E-Mail Classroom Connections, http://www.stolaf.edu/network/iecc/.

Tanaka, S. and Abe, H. (1989) The Language transfer in the foreign language learning - historical background and present-, *English education,* No, 1*,* 78-81, Taisyukan (in Japanese)

Tobita, Y. and Ro, Y. (1987) *Dictionary of Japanese and Chinese meaning*, Nan'undo (in Japanese)

Wardhaugh, R. (1970) *The Contrastive analysis hypothesis,* Teachers of English to Speakers of Other Languages Inc. Quarterly 4, 123-30.