

Agent-Mediated Language-Learning Environment Based on Communicative Gaps

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Abstract. This paper focuses on the problem of language transfer in foreign language learning. The transfer caused by the difference between learner's mother language and target language, often leads a communicative gap. This paper first analyzes the semantic relations between learner's mother language and target language. Then proposes a CGM (Communicative Gap Model) due to language difference. We have developed a communicative language-learning environment called Neckle (Network-based Communicative Kanji Learning Environment) to support foreign language learning through communication with native speakers. Neckle has a software agent that observes the conversation between the learner and the native speaker, checks up the communicative gap according to CGM, and notices the gap for the support of language learning congenial to each learner. Learners can not only be aware of the language difference but also acquire its cultural background from the native speakers.

1 Introduction

With the fast development of computer networking, people around the world have more chances to communicate directly. By applying computer networking to language learning, it is now possible for learners to communicate with native speakers in foreign languages. In fact, many approaches, which are intended to improve exchange among different cultures and language learning by e-mail, have been proposed [7,17,16]. Hanson et al. [7] used the Internet for improving international cooperation and comprehension among university students around the world. Through the exchange of e-mail, the learner's ability to comprehend and express themselves in foreign languages has been highly improved. Saita et al [16] examined the variation of learners' language misuse and corrected usages while learners communicated with native speakers by e-mail. Saita et al. reported that through the exchange of e-mail, the percentage of language misuse gradually declined, learners came to use sentences with more complicated structure, and the ability of the learner to use the language was improved. They also pointed out that to communicate directly with native speaker was very important for foreign language learning. These approaches that emphasize the foreign language study through communication, are known as a communicative

approach [11, 14]. A communicative approach is a foreign language learning method, which emphasize communication primarily. Grammatical rules and vocabularies are secondly. Recently, it has attracted much interest in CALL (Computer Assisted Language Learning). We apply this approach to support the acquisition of Japanese Kanji meaning with communication tools [12].

Cross-linguistic influences have also been identified as important factors influencing second language acquisition [15]. Language transfer means that one's mother language previously learnt tends to influence the learning a foreign language and have both negative and positive effects. It can be observed in conversation, semantics and phonemics. If a transfer takes place with no difference between the mother language and target language resulted it is called "positive transfer". If a transfer happens with different results it is called a "negative transfer". The "negative transfer" is a serious problem on foreign language learning usually causes a communicative gap [13, 15, 18]. Therefore, it is necessary to focus on the language difference in foreign language learning. In this paper, the system supports Chinese learners to study Japanese Kanji focusing on the meaning difference between Japanese Kanji and Chinese Kanji.

As for related researches, an intelligent CALL system called Mr.Collins [4, 5] was developed. It focused on language transfer that is caused by the grammatical difference between learner's mother language and target language. The system facilitated the acquisition of pronoun placement in Portuguese learning. 'Cross Talk' [10] is a CALL environment using multimedia based on cross-cultural pragmatics. It tackles on the issues of pragmatic transfer in the conversation between learner and native speaker. However, there are few approaches focusing on communicative gaps in CALL.

This paper proposes an agent-mediated language-learning environment called Neckle (Network-based Communicative Kanji Learning Environment) that focuses on the meaning difference between learner's ML (Mother Language) and TL (Target Language). In Neckle, a software agent that supports Chinese people learning Japanese Kanji is named Ankle (Agent for Kanji Learning).

2 Languages Difference and Communication

The "negative transfer"(hereafter sited as transfer) often leads communicative gaps. Contrastive linguistics is worthwhile work for predicting and preventing language transfer [20]. In this section, first, we analyze the relation of vocabulary meaning between learner's ML and TL. Then we consider the communicative gap due to the meaning difference.

2.1 Meaning Relation between ML and TL

The research of contrastive linguistics has been carried out on the relation between language's vocabulary meanings. Andou [1] classified the relation into 3 groups. (1) "Same", (2) "Overlap", (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. Figure 1 shows the relationship and some examples between Japanese and other languages.

- (I) Same: both of learner's ML and TL are signify the same or have common meaning. e.g., in Japanese, “春 (Haru)” means “Spring” only.
- (II) Inclusive: (IIa): The meaning scope of ML is a subset of TL; (IIb): The meaning scope of ML is wider than that of TL. e.g., in Japanese, “着る(Kiru)” means “put the clothes on ”only such as coats , jacket, not including such as pants, skirt , so “着る(Kiru)” belongs to (IIa). One the other hand, “兄弟(Kyodai)” in Japanese means not only brothers, but also sisters. So “兄弟(Kyodai)” belongs to (IIb).
- (III) Overlap-different: while ML and TL have common meaning, they also have different meaning. For instance, in Chinese, “单位(Tan'i)” has no meaning of “credit” like Japanese, it means “place of employment” instead. However, a common meaning of “a unit” exists, so “单位(Tan'i)” belongs to (III).
- (IV) Different: The vocabularies of ML and TL hav no common meaning because of different culture. For example, “鳥居(Torii)” is a symbol of Japanese culture. So the “鳥居(Torii)” is peculiar to Japanese language.

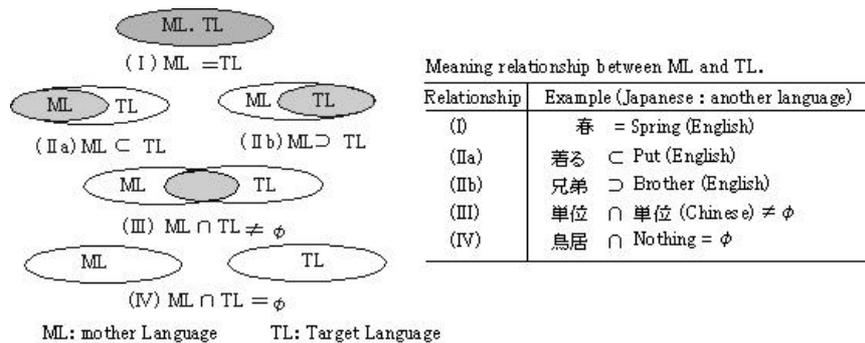


Fig. 1. Meaning relation between mother language and target language.

2.2 CGM (Communication Gap Model)

We have analyzed the factors of communicative gaps in conversation as follows:

- (1) Difference in meaning between learner's ML and TL: Learners may make misunderstanding of a word of TL because of the difference between ML and TL language[15]. When the meaning relationship is (II)“inclusion” or (III) “ they have common meaning and different meaning each other, a communicative gap may occur to learners.
- (2) Learner's position of the communication: Two positions exist in communication, one is a “sender” and the other is a “receiver”. Even if meaning is different, a

communicative gap might not occur depending on the learner's positions (sender or receiver).

- (3) Written form of learner's ML and TL (characters or letters): this system provides a text-based communication, therefore, it is possible that language transfer may occur even with the same written form. For example, if written form was different, there would be no gap. But, if the written form was the same, gap will occur. For example, “走” means “walking” in Chinese, but it means “running” in Japanese.

Table 1. Communicative gap model

Written form		Same		Different		
		Receiver	Sender	Receiver	Sender	
Meaning relation	Position					
	I	ML = TL	×	×	×	×
	II(a)	ML ⊂ TL	○	×	○	×
	II(b)	ML ⊃ TL	×	○	×	○
III	ML ∩ TL ≠ ∅	○	○	○	○	
IV	ML ∩ TL = ∅	○	○	×	×	

Considering the three above factors, we propose CGM (Communicative Gap Model) based on the different meaning (see Table 1).

- In (I), because the meaning is same, there will be no gap.
- In (IIa), when the student's position is a receiver, the student will take the TL's meaning with a narrower view than the TL, so a gap will occur. When the student's position is a sender, a gap will not occur because the native speaker is able to understand the meaning by the context.
- In (IIb), when the student is a receiver, it is not easy to understand native speaker intentions. When the student is a sender, a gap can occur if the native speaker takes the student's meaning into a narrower scope than the student intended.
- In (III), depending on a common meaning, a gap can occur at both student and the native speaker.
- In (IV), if the written form is different, a gap caused by language transfer will not occur. However, if written form is the same, a gap can occur at both the sender and the receiver.

3 Communicative Foreign Language Learning Environment

In this section, we present an agent-oriented framework, which focuses on the difference in the meaning between learner's ML and TL.

3.1 Design Strategies of Learning Environment

The design strategies of the framework are as follows:

- (1) Communicative approach: learners study TL through communication with native speakers.
- (2) Focusing on the language difference: this system mainly supports to acquire the knowledge where there is a difference between learner's ML and TL.

- (3) Learner-centered design: knowledge of TL is based on learners' needs and depends on the contents of the conversation. An agent supports language learning according to the communication contents and the status of student's understanding.

3.2 Diagram of Agent's Support

The agent's behaviors are as follows:

- (1) Agent observes the communication between learners and the native speaker.
- (2) Agent analyzes the conversation at real time using the "Dictionary of knowledge", and looks for the difference between learner's ML and TL.
- (3) Agent judges the communicative gap according to the CGM.
- (4) Agent notifies the knowledge difference according to the student model.
- (5) Agent constructs the intervening timing asking whether the student has already understood.
- (6) Agent decides the "teaching strategy" according to the response of learners. If a student's answer was wrong, the agent would notice the difference of knowledge according to certain teaching strategies.

3.3 Student Model and Intervention, Teaching Strategies

This study applies a communicative approach and supports students to learn foreign language through communication with a native speaker. The principles are as follows:

- (1) To avoid interrupting communication, the agent doesn't frequently intervene in the conversation.
- (2) Knowledge teaching does not interrupt conversation for a long.

We suggest the strategies of the system intervention and teaching based on the above principles.

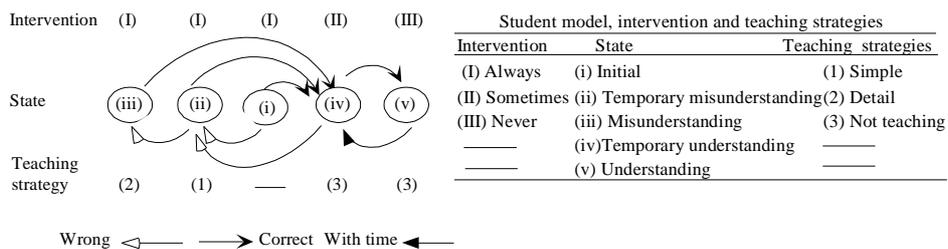


Fig. 2. Relation of intervention, student model and teaching strategies.

3.3.1 Student Model

In this system, we examined the state of student's knowledge by question. We classified the state of knowledge into "understanding" and "misunderstanding", then divide it further into "temporary understanding" and "temporary misunderstanding."

The status of student's understanding changes as in Figure 2.

- (i) Initial: Agent has not checked any Kanji words for meaning difference.
- (ii) Temporary misunderstanding: Learner's answer to a question was wrong, but only once.
- (iii) Temporary understanding: Learner's answer to a question was correct once.
- (iv) Misunderstanding: Learner's answer to a question was wrong again.
- (v) Understanding: Learner's answer to a question was correct again.

Each knowledge state will change according to the following rules. It will change to the state in written inside the < > symbols. when learner's answer was wrong. (see Figure 2)

- (i) (iv) <(ii)> : "Initial" moves to "Temporary understanding" if learner's answer was right. Otherwise, it moves to "Temporary misunderstanding".
- (ii) (iv) <(iii)>: "Temporary misunderstanding" moves to "Temporary understanding" if learner's answer was right. Otherwise it moves to "misunderstanding".
- (iii) (iv) <(iii)>: "Misunderstanding" moves to "Temporary understanding" if learner's answer was right. Otherwise, "misunderstanding" is repeated.
- (iv) (v) <(ii)>: "Temporary understanding" moves to "Understanding" if learner's answer was right. Otherwise, it moves to "Temporary misunderstanding".
- (v) (iv): don't intervene in conversation if state is "Understanding". However, "Understanding" moves to "Temporary understanding" with time.

3.3.2 Intervention Strategies

If there is any gap, the agent will intervene into the conversation as following, according to the student's model.

- (1) Always: The agent always intervenes if student's knowledge state was "initial", "temporary misunderstanding", or "misunderstanding".
- (2) Not always: Agent intervenes when "temporary understanding" appears several times.
- (3) Never: Agent does not intervene when the knowledge state is "understanding".

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

3.3.3 Teaching Strategies

In order to do not interrupt the communication for along time, we propose teaching strategies into "simple" and "detail" (See Table 2).

- (1) Simple: showing the diagram of relation between learner's ML and TL intended for "temporary not-understanding".
- (2) Detailed: teaching knowledge of meaning, spelling, grammar, and usage, etc. about TL intended for "misunderstanding".

4. Neckle

A system called Neckle (Network-based Communicative Kanji Learning Environment Focusing on the Difference between Japanese and Chinese Kanji Meaning) has been developed. Neckle has an agent interface called Ankle (Agent for Kanji Learning). In this environment, learners whose ML is Chinese learn Japanese Kanji through conversations with Japanese native speakers. This section we explain the development and user interface of Neckle.

4.1 System Architecture

Neckle has three parts: communication tool, Ankle and server. Communication tool uses text-based chat.

4.1.1 Ankle

Ankle always stays in learner's environment, supporting Kanji learning. It is composed of modules as following.

- (1) Monitor: it is used for recording a dialogue between the learner and the native speakers. It finds Kanji in the conversation and then, determines whether these Kanji have meaning difference consulting the "Dictionary of knowledge"
- (2) Agent interface: it is used for supporting knowledge learning.
- (3) Student model: it is used for recording the learners' status of knowledge, last attending date and attending times.
- (4) Mechanism of intervention strategy: if Kanji with meaning difference was used in conversation, the agent checks the gap existence according to CGM, notices a gap based on the learner model, and then determines intervention timing.
- (5) Mechanism of teaching strategies: Ankle intervened in the conversation with question. If the learner's answer was wrong, the agent will decide the teaching strategy by referring to the student model.

4.1.2 Server

The server is composed of the following modules.

- (1) Morpheme analyzer: a Japanese morpheme analyzer system. It analyzes the morphemes in a conversation and replays the result to Ankle.
- (2) Dictionary server: the Kanji knowledge of Chinese and Japanese is recorded in this base. It is used for Ankle to judge any difference and teach the Kanji knowledge.

4.2 User interface

The user interface is shown in Figure 3. It has five windows: "chat", "Ankle", "question", "teaching" and "dictionary".

- a) Chat window: the learner can engage in a real time dialogue with a native

speaker through the Chat system. For example, a Chinese learner “YU” and a Japanese student “MORI” talk about a major at the University. Their conversation is as follows:

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 people might understand into “Translator” only. So communicative gap might occur.

- b) Agent window: the agent Ankle has an interface of personification, which starts with the Chat window. It monitors the dialogue and intervenes when different knowledge is involved in the dialogue. Ankle provides the learner with the message and transmits the intention to the learner using a prepared dialogue template.

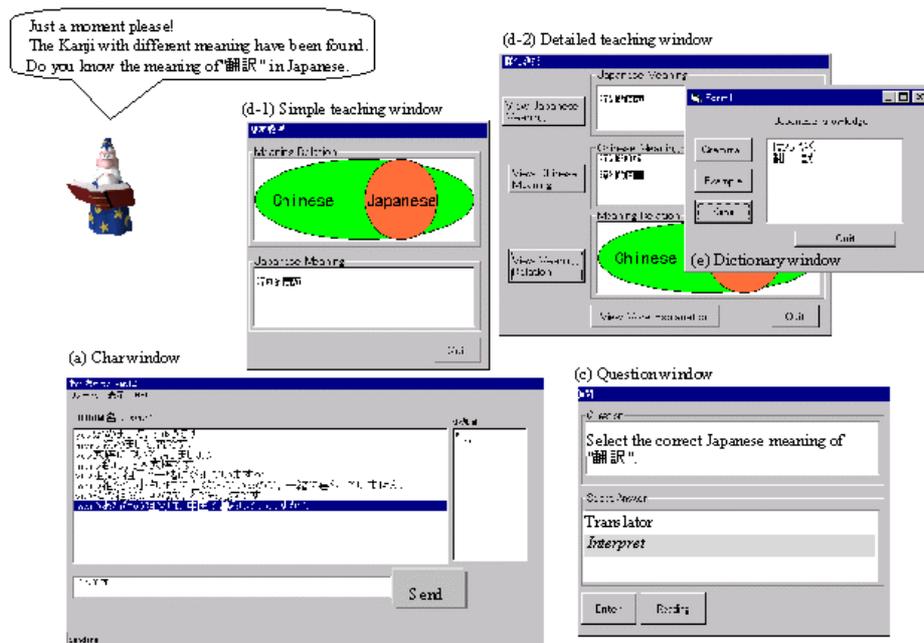


Fig. 3. User interface of Neckle.

- c) Question window: Ankle provides learner with a question. Checks the answer and informs learner about its correctness, with sound. Learner chooses from the choices. For example, about Japanese “翻訳(honyaku)”, it is correct if learner

chooses “Translator”, and the conversation can continue without Ankle’s intervention. However it is not correct if learner chooses “Interpreter”, then window (d-1) or (d-2) appears for teaching correct knowledge.

d) Teaching window:

(d-1) Simply teaching window: for “temporary misunderstanding”, the system gives operates with a diagram of the relationship of the Japanese-Chinese Kanji meanings. When the learner clicks a Japanese area, the meaning window will be popped up.

(d-2) Detailed teaching window: for “misunderstanding”, the system compares the learner’s Chinese with the Japanese meaning to support the understanding of Japanese meaning. If the student requests to know other knowledge, a dictionary window will be showed.

e) Dictionary window: in addition to the Kanji meaning, Grammar, spelling and so on are also provided.

6. Conclusions and future work

This paper deals with the problem of language transfer in foreign language learning and analyzes the meaning relation between learner’s ML and TL. We propose a communicative gap model based on meaning difference and suggest an environment for foreign language learning called Neckle. We also described an agent support that is a different approach from [2, 3]. Finally, we present the development of Neckle, which uses the agent Ankle, and show the experimentation about Neckle. Neckle was developed on the Windows NT using Visual Basic 6.0. Access 97 was used for the Database. Chasen [8] is the morpheme analyzer of Japanese, and the Microsoft Agent [9] was used as our agent interface. In the future work, we will make Ankle to consider more learners’ state of knowledge understanding, especially for advanced learners, and let the agent take part in conversation between learner and native speaker in a natural way. Secondly, we will try to apply Neckle to other languages.

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References

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

2. Ayala, G. & Yano, Y.: GRACILE: A Framework for Collaborative Intelligent Learning Environments, *Journal of Japanese Society for Artificial Intelligence*, Vol.10, No.6 (1995) 988-1002.
3. Ayala, G.: Modeling Software Agent for a Japanese Language Lifelong Learning Environment, *Proc. International Conference on Computer Processing of Oriental Languages 99*, (1999) 509-514.
4. Bull, S.: Promoting Effective Learning Strategy Use in CALL, *Computer Assisted Language Learning*, Vol.10, No.1 (1997) 33-39
5. Bull, S., Pain, H. and Brna, P.: 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* (1993) 121-126.
6. Bunkacho: *The Kango equivalent for Chinese*, research material of Japanese education (1978) 85-143 (in Japanese)
7. Hanson, J., Ribold, M. and Weber, P.: Cross Cultural Awareness, *Proc. World conf. on Educational Multimedia, Hypermedia & Telecommunications* (1998) 1900-1901.
8. Matumoto, Y., Kita, N., Yamashita, T., Hirano, Y., Ima, K. and Imamura, T: *System of Japanese morpheme analyzer – Chasen, Version1.0* (<http://cactus.aist-nare.ac.jp/lab/nlt/chasen.html>) (1997) (in Japanese)
9. Microsoft Corporation: *Microsoft Agent Documentation*, (<http://msdn.microsoft.com/workshop/imedia/agent/documentation.asp>) (1999)
10. Mike Levy: Theory and Design in a Multimedia CALL Project in Cross - Cultural Pragmatics, *Computer Assisted Language Learning*, Vol.12, No.1 (1999) 29-57.
11. Keith Johnson and Keith Morrow: *Communication in the classroom: applications and methods for a communication approach* London: Longman. (1981)
12. Liu, Y., Ogata, H., Ochi, Y., and Yano, Y.: Agent based Computer Supported Language Learning Environment focusing on Languages Distinction, *Proc. International Conference on Computer Processing of Oriental Languages 99* (1999) 261-264.
13. Lado, R : *Linguistics across cultures: applied linguistics for language teachers*. Ann Arbor: Michigan University Press. (1957)
14. Okazaki, T., Okazaki, H.: *Communicative approach in Japanese education*, Bonjinsya (1990) (in Japanese)
15. Odlin, T.: *Language Transfer, Cross-Linguistic Influence in Language Learning*, Cambridge University Press. (1989)
16. Saita, I., arruson, R., Itoman, D., Otubo, K., Mtuzaki, H., Kawazoe, Y.and Iguti, N.: Designing Japanese Language Learning using Email, *Journal of Japanese Language Teaching Society* (1996) 49-54 (in Japanese)
17. St. Olaf : *College Intercultural E-Mail Classroom Connections* (1989) <http://www.stolaf.edu/network/iecc/>.
18. Tanaka, S., Abe, H.: The Language transfer in the foreign language learning -historical background and present-, *English education*, No, 1 (1989) 78-81, Taisyukan (in Japanese)
19. Tobita, Y., Ro, Y.: *Dictionary of Japanese and Chinese meaning*, Nan'undo (1987) (in Japanese)
20. Wardhaugh, Ronald: *The Contrastive analysis hypothesis*, Teachers of English to Speakers of Other Languages Inc. Quarterly 4 (1970) 123-30.