

Interactive Question-Posing Environment for Beginners' English Learning

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Abstract. Several investigations have already suggested that question-posing is a promising learning as well as a problem-solving activity. In order to realize this learning method, however, how to give feedback for the posed questions becomes a big issue. In this paper, we describe an interactive learning environment that promotes learning by question-posing in English learning for beginners. The learning environment supports learners to pose question and answer sentences. The most important characteristics of the learning environment are automatic assessment of the posed questions and feedback based on the assessment. We call this assessment as agent-assessment. To realize these functions, we have used automatic question generation techniques from English sentences proposed in our previous researches. Preliminary evaluations and related works are also described in this paper.

Keywords: Question-Posing, English Learning, Agent-Assessment

1. Introduction

An interactive learning environment for question-posing of English learning has been already designed and developed. In the learning environment, a learner reads an English short text first. The learner is, then, required to pose question sentences and answer the questions themselves. The learning environment has ability to assess both the questions and the answers, as well as to give feedback to learners based on the assessment. We also carried out an experimental use of the learning environment.

Several investigations have already suggested that question-posing is one of the promising learning as well as problem-solving activities [1, 2, 3]. In learning by question-posing, assessment and feedback for the questions & answers posed by learners are important issues. Although to make learners assess the questions & answers by themselves is worthwhile as a kind of learning activity, accuracy of the assessment cannot be secured especially for beginners. If the questions or answers included with errors, it is necessary to detect them and also to support to correct them. Mutual assessment between peer learners includes the same difficulty. Teachers are involved to assess questions & answers and to give adequate feedback; however, to take care of question-posing by several learners simultaneously is a heavy task because the learners are usually allowed to pose various kinds of questions. Due to the above-mentioned reason, we have investigated the function of automatic assessment of questions & answers posed by learners in technology-enhanced learning. We consider the framework of the automatic assessment as “agent-assessment”, because the first one of the above-mentioned assessments is often called as “self-assessment”. The second one is “peer-assessment” and the last one is “teacher-assessment”. Here, agent-assessment is not having any conflict with the other types of assessments because it can be used as basic information for self-assessment, peer-assessment and teacher-assessment.

We have already developed several interactive learning environments for learning by question/problem-posing such as target arithmetical word problems [4, 5, 6] and mechanics problems [7]. In these studies, master the use of a solution method is the aim of the learning and the learners are required to pose problems that can be solved by the specified solution method. In English learning, question-posing is a well-known effective learning strategy with wider learning goals. Chan [8] indicated four different effects due to learning by question-posing as follows; (1) the students' awareness can be improved and their thinking can be controlled, (2) long time retention of knowledge and skills can be improved, (3) ability to apply and transfer the knowledge, and (4) attitude and motivation can be improved. As a concrete method of question-posing, Schumaker [9] proposed a procedure where a learner is promoted to find a clue word first in a text and then to pose question & answer sentences including the clue. Based on the proposal, we have designed and developed a learning environment for clue word based question-posing targeting learning English.

In this paper, question-posing in learning environment is described. Authoring method to realize agent-assessment is also explained. Besides, results of experimental use are reported in this paper.

2. Learning by Question-Posing

In learning by question-posing environment, a learner is first required to read several sentences. Then the learning environment requests the learner to select a clue word from a list of keywords that are extracted from the sentences, and promotes the learner to pose a question related to the clue word. To pose a question, the learner is provided with a set of words and required to make question as well as answer sentences by combining the words. The posed questions and answers are then assessed by the learning environment. If an error is detected, feedback concerning the detected error is given to the learner. In this section, the framework of learning by question-posing is described in detail. The way to realize the agent-assessment is also explained in the next section.

2.1 Flow of Question-Posing

By using the following sentences as an example, the flow of question-posing is explained.

Australia has many kinds of interesting animals. Koalas are very popular. They sleep during the days. Look at the mother koala in the picture. She has a baby on her back.

After reading and comprehending the sentences, a learner is required to select a clue word that should be included in the question and/or answer the learner will pose. In Figure 1, the learner is selecting the noun 'Australia' from the list of clue words at the right side of the interface.

In the second step, the system generates pairs of questions and its answers from the sentences. For instance, when a learner has already selected the word 'Australia' as the clue word, the system generates several questions and answers including 'Australia' from the sentences. Following two pairs are examples that are generated by the system.

What has many kinds of interesting animals? -----Australia does.

How about koalas? -----koalas are very popular.

Currently, the target questions are restricted in interrogative pronouns, that is 'who', 'what', 'when', 'where' and 'how'. In order to promote the question-posing, the environment provides the learner with a list of interrogative pronoun and requests to select one of them. In this example, selectable interrogative pronouns are 'what' and 'how'. If the learner selects other interrogative pronouns, that is, 'who', 'when', or 'where', the system indicates that it is impossible to pose questions and answers with the interrogative pronoun for the current sentences. Here, it is assumed that the learner has selected 'what'.

In the third step, the system provides the learner with a set of words that is enough to pose a question correctly, and the learner is requested to compose a question sentence with the words shown in Figure 2.



Figure 1. Selection of a clue word.

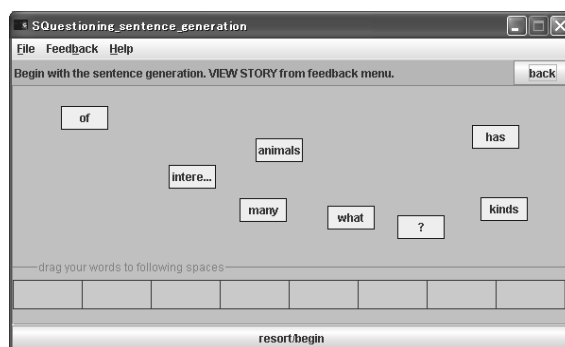


Figure 2. Words as components of a sentence.

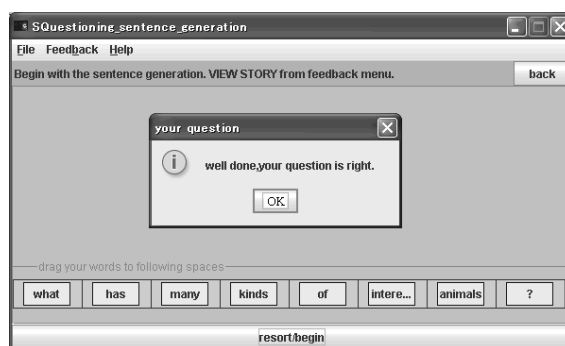


Figure 3. A question posed by arranging the words.

In the fourth step, the learner arranges the words to generate a question sentence. In the assessment, the generated sentence is compared with the prepared correct question. In Figure 3, the learner generates the correct question as: '*what has many kinds of interesting animals?*' The feedback to wrong sentence is explained in the next subsection. When the learner posed a question correctly, the learner is required to make an answer of the question by arranging provided words in the same way. This is one type of question posing in this learning environment.

2.2 Feedback

In the system, four kinds of feedbacks are provided for an error in question-posing as follows.

- (1) If a learner selects a wrong interrogative pronoun, the system indicates the learner that it is impossible to pose a question with the interrogative pronoun.
- (2) If there is a mistake in the order of the words, the system indicates the wrong words and requests to rearrange them as shown in Figure 4.

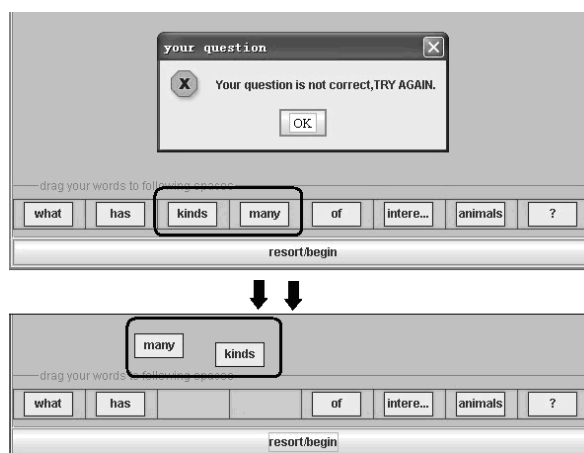


Figure 4. Rearrangement of the words.

- (3) If a learner cannot make any questions or answers, the system provides related sentences to the selected clue word and promotes the learner to read them again.
- (4) If a learner cannot make any questions even if the related sentences were provided, the system itself poses questions and answers as examples.

Although the current feedback is useful for a learner to be aware of his/her errors, it is not explained the reason why the questions and answers are wrong. Sophistication of the feedback is our important future work.

3. Authoring Module

In order to realize this learning by question-posing, it is necessary to prepare a lot of questions and answers for each text. This preparation is usually hard task. In our framework, authoring module has been developed to prepare the questions and answers. We have investigated an automated question generation function for an intelligent English learning system [10, 11]. The function uses syntactic and semantic information of an original text generated by natural language processing techniques, and dictionaries of synonyms and antonyms. To extract the syntactic and semantic information, DCG (Definite Clause Grammar) is used [12]. We have experimentally confirmed that 80% of questions appeared in four English textbooks for novice learners in Japan can be generated by the functions. Then, almost 90% of questions generated by the function are syntactically and semantically adequate. In our authoring module, this automatic question and answer generation function is adopted.

Since some of the generated questions and answers are inadequate ones, it is necessary for authors to select adequate questions and answers from the list of questions and answers that automatically generated. Here, the task to generate questions and answers is simplified to the task to select them from the list of sentences. It is also possible to modify the selected ones or to add several questions and answers. As for clue words, authors can select adequate ones from the list of nouns derived from the original sentences.

In Figure 5, sentences of the questions and answers generated by our system are shown in the area of ‘expert sentence’s panel’ on upper-right hand. While, author clicks one of the generated sentences, the clicked sentence would appear on the ‘modifying sentence’s panel’ below the figure. The author can modify the sentences by changing, rearranging or deleting the words and can also save and delete the sentences.

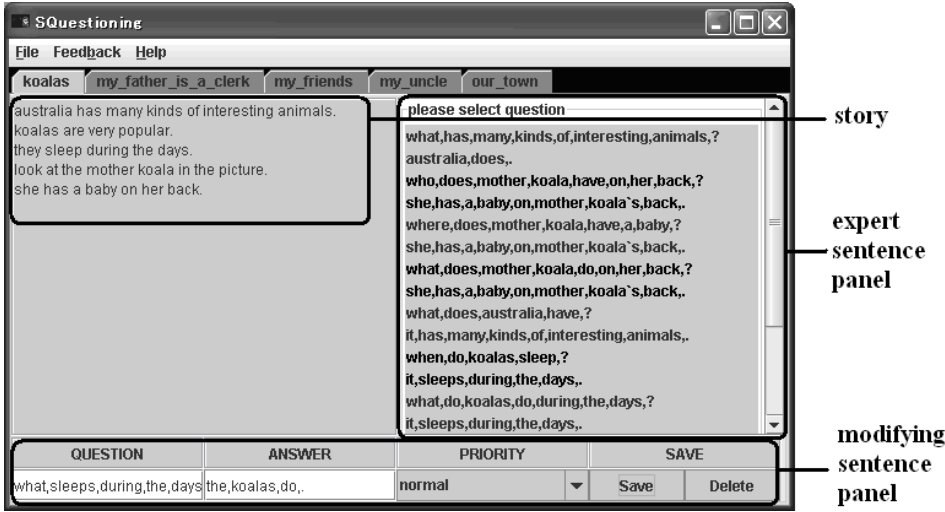


Figure 5. Sentences Modification Function.

4. Preliminary Evaluations

We have evaluated the learning environment from the viewpoint of “learning” and “authoring”. Since the subjects in this evaluation were not real users, the number of subjects was small and the experiment time also was short, these evaluations are preliminary ones. We have however judged that these experiments were strong enough to examine the possibility of this research.

4.1 Evaluation of Learning Module

The subjects were 15 master course students in the graduate school of engineering. They have at least 8 years experience of regular English lessons. In this experiment, they were engaged in question-posing with both the learning environment and pencil&paper. The subjects were then asked to compare the question-posing in the learning environment with the question-posing on pencil&paper. In addition, three English teachers were asked to evaluate the questions and answers that were generated in both the conditions. This was a preliminary evaluation of the learning environment to examine promising activity.

4.1.1 Comparison of Question-Posing between Pencil&paper and Learning Environment

We prepared four texts as learning materials and requested the subjects to pose questions with pencil&paper for two out of four texts and with learning environment for other two texts. The subjects are divided into two groups and it is counterbalanced with the assignment of the texts. Each text was composed of 64 words in average. All texts were picked up from the beginner English texts.

In the first step of the experiment, we explained the meaning of the question-posing and then distributed two texts with a paper and asked them to write three pairs of question and answer sentences for each text on a paper. We call this type of question-posing as “pencil&paper”. In the next step, after explaining the operation of the system, the subjects were requested to generate three pairs of question and answer sentences by using the

learning environment. Here, 30 pairs of questions and answers are prepared for each text in average. After the use of the system, the subjects answered the questionnaire. The results are shown in Table 1. All subjects agreed that question-posing with the system was useful for learners. In comparison, almost half of the subjects judged the learning environment system as better than pencil&paper in English learning. No one judged the system was worse than pencil&paper. These results suggested that learning by question-posing with the system is a promising learning method for English.

Table 1. Results of Questionnaires for the Learning Environment

QUESTIONS	ANSWERS			
	Strongly Agree	Agree	Disagree	Strongly Disagree
Do you think the clue words supported by the system are useful to generate questions and answers with?	11	4	0	0
Do you think the feedback which indicates errors from the system is useful to generate questions and answers?	10	3	2	0
Do you think question-posing with the system is useful for learners to learn English?	9	6	0	0
	Self-questioning	teacher	both	neither
Which is the more effective English learning method, to answer the questions what given by teacher or to answer the questions what generated by yourself (question-posing)?	5	0	10	0
	System	Pencil&paper	both	neither
Which is easier to make questions and answers, the system or the pencil&paper?	14	0	0	1
Which is effective to learn English, the system or pencil&paper?	7	0	7	1

4.1.2 Evaluation of Quality of Questions and Answers

Since questions that can be posed in the system are limited, it is necessary to examine the quality of questions in comparison with questions of pencil&paper, that is, unlimited situation. We asked three English experts (TOEIC more than 800 points) to analyze 180 pairs of questions and answers generated in both pencil&paper and system conditions. Two of them are English teachers and one of them has the experience as an English teacher. They were requested to categorize the 180 pairs of sentences into three levels as low (1 point), middle (2 points) and high (3 points). Since the pairs are mixed together, they didn't know the generation conditions of the pairs. If a pair is judged as low level, the pair is obtained one point. The scores are shown in Table 2. The average points of them are almost same. This result suggested that quality of questions posed in the system was not low even in the restriction of questions-posing way.

Table 2. Scores of Questions and Answers

evaluator	average point	
	pencil&paper	system
person A	1.41	1.62
person B	1.22	1.25
person C	1.96	1.82
average	1.53	1.56

4.2 The Experiment Use of the Authoring Module

In our preliminary experiment of authoring module, we required three subjects to use the system. The subjects' average TOEIC score was around 700. Their task was to prepare useful and adequate learning materials for the question-posing module. In order to prepare

the materials, they need to use the sentence modification and clue words selection functions of the authoring module. After using the system, they would answer the questionnaire. The information about the using time, the number of the texts, number of questions generated by the system, and number of questions modified by the subjects are shown in Table 3. Here, the modified questions meant the questions which are generated by system are not correct. The questionnaires' result is shown in Table 4. As a result, all subjects agreed that the authoring module is useful to prepare the materials.

Table 3. Results of Authoring Experiment.

	Time	Text	Generated questions	Modified Questions
subject A	11 minutes	2	15	7
subject B	12 minutes	2	13	6
subject C	10 minutes	2	13	6

Table 4. Results of Questionnaires for the Authoring Module

QUESTIONS	ANSWERS			
	Strongly Agree	Agree	Disagree	Strongly Disagree
Were you able to prepare correct sentences with the authoring tool?	3	0	0	0
Were you able to find adequate clue words with the authoring tool?	2	1	0	0
Do you think the questions that you made are useful for learning?	3	0	0	0
Do you think it is easy to prepare the correct sentences and clue words if you use the authoring tool?	1	2	0	0

5. Related Researches

In English technology enhanced learning, there are several related researches for question-posing. In question bank [13], a learner can pose questions on the website to get answers from other learners. This is a kind of realization of learning by question-posing with peer-assessment. Mostow and Chen have developed a learning environment of self-questioning with agent-assessment [14]. Almost, this is similar to our research approach. Their main research target, however, was to generate questions and their answers from a given text from the viewpoint of natural language techniques. In their research, the way to pose a question is very simple, that is, a learner is required to select a word one by one with menu operations. Then the authoring module to compensate the incompleteness of automatic question generation function has not been discussed. Moreover, although they have evaluated the system on a corpus, it has not been used in a learning context. Therefore, we could say that their research is near to our previous researches about automatic question generation [10, 11]. Based on these considerations, main contributions of our research are in the advanced idea and method to make use of the techniques of automatic question generation in the context of learning by question-posing.

6. Conclusion

In this paper, an interactive learning environment of learning by question-posing has been introduced and preliminary experimental evaluations are reported. Question-posing is well known as a useful learning activity in understanding of the questions themselves, their

answers and solution methods for the questions. To conduct this learning activity, however, is often difficult for learners. To realize the learning activity to be more common one, we have designed and developed an interactive learning environment that promotes learning by question-posing in English learning for beginners. In the learning environment, learners are supported to pose question sentences and answer sentences. The most important characteristics of the support are automatic assessment of the posed questions and feedback based on the assessment. To realize these functions, we have used automatic question generation techniques from English sentence proposed in our previous researches. In this paper, question-posing in this learning environment and authoring module to realize agent-assessment with the automatic question generation techniques have been described. Preliminary experiments and related works are also elucidated in this paper.

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