Reading Aloud Training Game for Children with Auto Evaluation of Oral Reading Fluency

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Abstract. Reading aloud is an important study method of acquiring information and building knowledge from text. This article proposes an objective and automatable method that evaluates fluency of children's reading by reflecting the evaluation by those who are experienced in book reading (to children), and presents the outcomes of building an automatic evaluation system on the fluency of reading with that method.

Keywords: Read aloud training · Gamification · Evaluation of oral reading fluency

1 Introduction

Upon obtaining information and building knowledge, reading aloud is a basic and important learning method. It has been indicated that there is a correlation between children's fluency in reading aloud and their reading comprehension [1]. It has been also indicated that, by enhancing children's fluency of reading aloud, their reading comprehension can be also enhanced [2]. Therefore, it can be said that it is important to enhance children's fluency in reading aloud.

In this article, by reflecting the evaluation of reading fluency by those who are experienced in book reading, an objective and automatable evaluation method on children's reading fluency was proposed, and using that method, an automatic reading fluency evaluation system was built. Upon building the system, it was designed to be capable of enhancing children's reading fluency in their reading practices with the automated evaluation system without having a teacher with them. In the evaluation experiment of the proposed system, the actual system was used by children, and a questionnaire survey was conducted on both children and their parents. As a result, it was revealed that the proposed system was easy to use, and it enhanced children's motivation for reading aloud, resulting in the enhanced reading fluency, not only in the material they practiced on, but also in other materials as well.

2 Game Design

The proposed system aimed to be a system that could motivate children to practice reading, and to help enhance their reading fluency. By implementing the proposed system in a terminal, it would allow children to practice their reading aloud and have it

evaluated anytime without having a teacher or parents around. In order to realize such system, three requirements were set: (1) being capable of enhancing children's reading fluency, (2) being capable of motivating them to practice reading aloud, and (3) being easy to use.

The reading-aloud game consists of three functions: the reading-aloud practice function, practice recording function and the raising game function. The screenshot of the reading-aloud practice function is sown in Fig. 1. A line of the text is displayed in the screen each time, and children read it aloud one by one. Once they have completed reading the whole text, it will display their scores of reading aloud as shown in Fig. 2, using the automated fluency evaluation system that would be described later in this article. The evaluation uses three patterns of (1) 'not fluent', (2) 'neither' and (3) 'fluent'. These marks are shown in a, b and c in Fig. 2.

The reading-aloud practice recording function keeps record of reading-aloud practices. This function consists of switchable two different screens: visualized display of the number of practices and the evaluations as shown in Fig. 3, and text-written displays of the dates and evaluations as shown in Fig. 4.

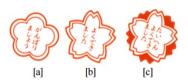**Fig. 1.** Record of oral reading practice1

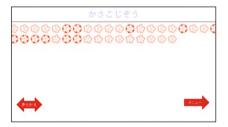**Fig. 2.** Record of oral reading practice2
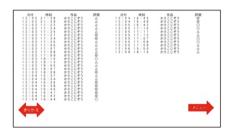

Fig. 3. Record of oral reading practice3

Fig. 4. Record of oral reading practice4

The raising game function is created for the purpose of motivating children to practice reading aloud. They can raise a 'character' with their scores and the number of times they are evaluated. They can play with this character, going on adventures in response to the number of times they practiced.

3   Automatic Evaluation of Oral Read Fluency

As the evaluation of reading fluency, S'IPA proposed in [3] was used. S'IPA averages the time duration of each phoneme recorded in advance in children's readings, and took the difference from what was recorded during the automatic evaluation. This is defined in the following formula.

$$s_{\mathrm{IPA}} = \sum_{i=1}^{L} \left| \overline{IPA_i} - IPA_i \right|$$

$$\overline{IPA_i} = \frac{1}{N} \sum_{x=1}^{N} IPA_{i,x}$$

'IPA' is the time it takes to read the i-th phoneme, comma or period, and 'IPAi, x' is the time the reader 'x' took to read the i-th phoneme, comma or period. 'L' indicates the numbers of phonemes, commas and periods in the reading material. The detailed explanations on 'S'IPA' will be referred in [3].

The evaluation of reading fluency was automatically conducted by quantifying the reading fluency using S'IPA, setting the threshold values. When the result was below the lower threshold value, it is defined as 'fluent', when it is in-between the two thresholds, it is 'neither', and when it is higher than the higher threshold, it is defined 'not fluent'.

In [3], taking into account the close correlation with the fluency, the applicability of the reading fluency evaluation index was verified that indicated that S'IPA was best applicable. In addition, it suggested that CIPA and C'IPA that used average time length of each phoneme in model reading materials are the index adequately applicable to evaluate the reading fluency.

4   Experiments

After having 8 children participate in the reading-aloud practice for a week, an evaluation experiment was conducted by having a questionnaire survey on both children and their parents. By having the parents evaluate children's reading before and after the practice according to the items of Table 3, the improvement of fluency was observed in all the reading materials as shown in Table 2. Among the reading materials, significant improvement was observed in the material A and C, and those children who practiced reading with the proposed system not only improved in fluency of reading in the practiced material, but also in other materials as well. From this result, it was suggested that the proposed system was capable of enhancing children's general fluency of reading.

Moreover, the usability of the system was asked to the children. The content of the questions and the obtained answers were shown in Table 1. All the question items received favorable answers as shown in Table 1, and it was revealed that they found the proposed system easy to use, and were motivated to practice reading.

Table 1. Questionnaire and choices

Question	Did the child read it fluently?	
Choices	12	Yes. VERY Fluent.
	11	Yes. Very Fluent.
	10	Yes. Fluent.
	9	Yes. A little fluency.
	8	Neither. Become fluent a little more.
	7	Neither. If I had to choose one, fluent.
	6	Neither. If I had to choose one, non-fluent.
	5	Neither. Become non-fluent a little more.
	4	No. A Little non-fluent.
	3	No. Non-fluent.
	2	No. Very non-fluent.
	1	No. VERY non-fluent.

Table 2. Questionnaires about oral reading practice and the proposed system

	Question	Anser
1	Was it fun to practice reading reading?	5.0
2	Did you practice reading well?	4.0
3	Did you do your best and practice?	4.4
4	Did you feel bad when you were practicing?	1.4
5	Was it easy to use?	4.9
6	Was the scoring result help-ful?	4.5
7	Did you help in practicing reading aloud?	5.0
8	Can you keep using it all the time?	4.6
9	Do you want to USE it again?	4.8

Table 3. Result of oral reading fluency evaluation

	Before	After
Book 1	8.3	9.1
Book 2	8.5	8.8
Book 3	6.8	7.8

Furthermore, as a questionnaire survey was conducted on the parents, it was reported that there were children who practiced reading-aloud proactively everyday, or who raised hands to speak during Japanese class, as well as those who became better in reading aloud in short time. However, since the system offered only one reading material this time, it was reported that some children got bored after a while.

5   Conclusion

In this article, an automatic evaluating system on the fluency of reading aloud was developed, using the evaluation index that reflected the evaluation by experienced book readers (to children). In the children's fluency evaluation, the feature amount S'IPA that compared the time duration of each phoneme read by a child with the average time duration of the preliminarily recorded reading. The evaluation experiment of the proposed system revealed that it was capable of enhancing the fluency of children's reading. Moreover, children were able to use the proposed system easily, and became motivated to engage in reading aloud proactively. On the other hand, as the system offered only one reading material, it would be necessary to have multiple materials to keep children interested.

References

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