Developing Software for Dynamic Displaying of Chunks to Enhance Reading Efficiency

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ABSTRACT

In a CALL environment for Japanese EFL university students, we have long been successfully enhancing students' reading efficiency (RE) using customised application software with a dynamic display of chunked text. In this practice, students read silently or aloud a certain number of passages using a software named Mint in each lesson. In order to assess the learning effects of this practice, we measured students' WPM (Words per Minute) and comprehension rate, and provided affective questionnaires in pre- and post-test during one semester. Under such conditions, the recent attempt of phonetic training to enhance RE has had some significant effects. However, in 2014, we revised our software to allow more precise measurement of WPM and comprehension rate, and to provide instant feedback. More importantly, this new software, Mewm, integrates the effect measurements and classroom practice, so that students can see their results not only in the pre- and post-tests but in every lesson. This integrative software has the potential to motivate our students and facilitate their reading efficiency, acting as a pacemaker. Finally, we examine the potential of this software according to responses from students who tentatively used it during one semester.

KEYWORDS: CALL Software, Chunking, Reading Efficiency, Oral Reading, Display Mode

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Introduction

In the information age, the ability to read English information efficiently and quickly is a necessary skill. Japanese learners of English, however, are often slow readers because they are taught using the grammar-translation method, which causes them to parse and translate English sentences into Japanese word by word. This reading method inflicts an unwanted burden on the process of decoding and memorising information in a passage, for example, semantic content at the beginning of a passage may be forgotten by the end because of the limits of short-term memory, so that it is difficult to grasp even the main idea or theme of a passage (Kanda, Yubune, & Tabuchi, 2010). Thus, spending too much time translating and parsing results in poor understanding of a passage's context.

Reading efficiency

As Carver (1989) suggests that developed reading ability entails reading speed, if effective reading requires a certain speed, it is necessary to accelerate the reading speed of learners while retaining as much comprehension accuracy as possible. Hence, the aim of the present research is for learners to read efficiently. With this research aim, reading efficiency (RE) is an appropriate index or tool to improve students' reading speed and accuracy. RE, then, refers to the product of accuracy and speed of text reading (Fry, 1963; Geva & Yaghoub-Zadeh, 2006), and is calculated as WPM (Words per minute) multiplied by reading comprehension rate (Table 1). Hence, RE can indicate both speed and accuracy of reading.

Table 1. Virtual examples of the calculation of reading efficiency

WPM	comprehension rate	reading efficiency
100	60%	60
150	60%	90
200	60%	120
300	60%	180

Another function of RE that serves our research aim is in facilitating Japanese learners to place more emphasis on reading speed rather than accuracy. This is important since our Japanese learners, who are unaccustomed to fast reading, are likely to concentrate on accuracy and translation into Japanese. In fact, reading speed contributes substantially to RE enhancement, unless the reading rate is 0%. While reading rate cannot exceed 100%, WPM can exceed 100 or are unlimited in number (Table 1). In this multiplication, WPM may seem to our learners to be a stronger factor in enhancing RE. Thus, if our learners aim to enhance RE at all, they must read faster. We do not believe that any trade-off between speed and accuracy will be taken seriously. Accuracy will follow if learners first become accustomed to a certain reading speed through proper training. The same can be applied to cases where RE is enhanced without any improvement in comprehension rate; this should mean that a learner reduces the amount of time spent on the same rate of comprehension, which can be said to improve the quality of reading. Accuracy of comprehension is also expected to improve later.

Chunking text

With this background, since 2007, we have been trying to enhance the RE of Japanese university students of English by using fast-reading training software with a chunking text on a PC display. Here we should explain why we use chunking text. A chunk is considered a processing unit of sound, meaning, and syntax with a duration of 2±1 sec., and can also be termed Sense Group or Breath Group (BG) (Jones, 1960), Tone unit (Halliday, 1967), Word group (O'Connor & Arnold, 1973), or Intonational Group (Jackendoff, 2002). In our practice, we have segmented one chunk by approximately 5 to 7 words in each sentence. This unit was reported to help learners better process the meaning and structure of sentences (Ohtagaki & Ohmori, 1990) in English word order, not to read back and forth to parse and translate them into the learners' native language. Other studies (Kadota, Yoshida, & Yoshida, 1999; Yoshida, Yoshida, & Kadota, 1998; Yubune, Kanda, & Tabuchi, 2007; 2009) show that a display method of chunked phrases and clauses could significantly enhance reading speed. On the basis of these prior studies, we have long focused on a chunk as a sustainable effectual factor for reading accurately and faster.

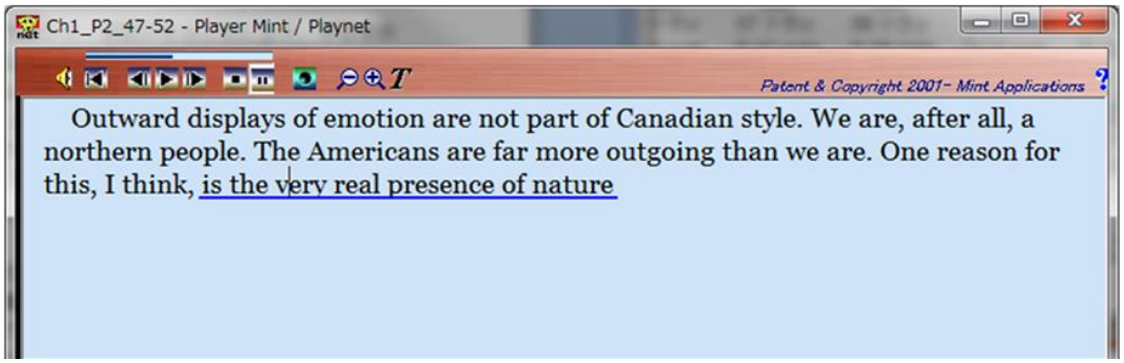
Cognitive psychology also underlies the use of chunked text in foreign language processing. As reported in Yubune and Tanuchi (2013), most chunks, or Breath Groups, of the English language extend for approximately 2.0 seconds or less. This duration almost parallels the hypothesised time constraints of phonological loops in working memory (Baddeley, 2000). Baddeley claims that we understand a stretch of words and memorise them when they are temporarily stored in the phonological loop, which only retains the information within two seconds of being phonologically decoded. Miller (1956) and Cowan (2001), on the other hand, claim that linguistic items such as phonemes, syllables, or words constitute a chunk. Miller proposes the 'magical number plus minus seven' and Cowan four items, respectively. Miller called the number 'magical' because there was no psychological or physiological reasoning behind the number. These theories suggest that a stretch of linguistic information that exceeds two seconds in duration or four/seven items is difficult to process and thus cannot be easily understood and memorised even for native English speakers. Therefore, chunk-based language training should be cognitively simpler for learners and thus accelerate learning by reducing excessive cognitive load and helping them focus on what they really need to learn.

Dynamic display mode of chunks on software

The next question is why we have used CALL software. We have assumed that using chunked text on a PC display is effective at improving the reading of novice Japanese learners of English. However hard they may try to read text quickly on printed paper, their tendency to read English sentences back and forth may not change, because text printed on paper cannot force their eye movement in the direction of English word order. On the contrary, a display-driven method is expected to propel them to read faster straight along the word order, since human eyesight is often reactive to the motion of an object.

To achieve this method, we used a software programme called Multimedia Player Mint (Mint), developed by Mint Applications Co. LTD. and currently run on Windows® in the Japanese language environment. On the programme display, underlined chunks appear consecutively with a prompter that runs along the text at the average speed of reading voice, so that students can read at the speed of a native speaker's voice (Figure 1). This software simultaneously measures learners' WPM. Having finished reading, students are required to answer online comprehension quizzes and then receive instant feedback regarding their WPM and comprehension rates. Such feedback is expected to make students aware of their own reading speed and increase their motivation.

Figure 1. Display mode in which consecutive chunks appear and remain on screen



Aside from the above silent reading practice, in recent years, we have given students phonological-based training using Mint. This training includes oral reading, repeating, and shadowing, conducted individually or as a class using the above dynamic display mode of Mint. At any rate, we have long used this simple but effective software, which allows the display of dynamic chunked text together with a synchronised reading voice. In this CALL environment of using the chunking software, our ultimate research aim is to ascertain how to enhance students' RE in the actual classroom setting, rather than as a virtual laboratory experiment.

Two recent studies of oral reading practice

In the aforementioned classroom conditions, each class in our research participated in a reading activity using Mint once a week in accordance with the environment and principles of each class. In order to measure the learning effects of this treatment, we gave students pre- and post-tests over one semester to measure their WPM and comprehension rate.

Each test was composed of four reading passages, each containing five comprehension quizzes, and 20 listening questions. Full marks for both reading and listening comprehension are 20. The test items were all adopted from the pre-level 2 English Language Proficiency Test in Japan, in which difficulty level is properly adjusted by the Society for Testing English Proficiency, which is recognised by Japan's Ministry of

Education, Culture, Sports, Science and Technology. In addition, Japanese students are quite familiar with this style of test.

The listening questions in the pre- and post-tests aimed to confirm the transfer effect of reading on listening ability. In addition, we administered an affective questionnaire to assess changes in students' cognitive and mental attitudes toward reading as mentioned below in Table 4. Students were required to answer questions on a 5-point Likert scale.

Furthermore, in order to ensure the reliability and validity of the data, we have run experimental groups and one comparison or control group, each of which has more than 20 students. Within the main research aim of enhancing reading efficiency, the following research question was formulated and addressed in this study:

> How does phonological training using dynamic display on software affect learners' reading speed, comprehension rates, and mental and cognitive attitude toward English reading?

Behaviour of WPM and comprehension rates

In 2011 and 2012, a study was conducted that measured the effects of training using Mint on learners' WPM and comprehension rates (Yamaguchi et al., 2015). In 2011, three groups of university learners, referred to as groups A, B, and C, were assessed in pre- and post-tests. All groups used Mint for 10 minutes in each English lesson throughout the academic year. Group A comprised 15 learners who read aloud chunk-by-chunk in unison with the whole class, after first understanding a passage in English. This group of learners liked learning English. Group B comprised 12 learners who, having first understood an English passage, read aloud chunk-by-chunk, not in unison with other students, but individually. Group C comprised 16 learners who read silently chunk-by-chunk in order to understand an English passage (Table 2).

All groups improved their RE and WPM statistically after the learning treatment which lasted for an entire academic year. Group A showed the most significant improvement of their reading skills. These results show how effective the reading training using Mint is, whether learners of English try to understand a passage or read aloud after understanding a passage, but the results may have been influenced by the favourable attitude of group A towards learning English.

Table 2. Treatment Type in 2011

Group	When to read	How to read
A	read after understanding a passage	read aloud in unison with a whole class
B	read after understanding a passage	read aloud individually
C	read in order to understand a passage	read silently

Therefore, in 2012, we assessed all those learners who neither liked nor disliked learning English–groups D, E, F, and G. These groups were also university students in Japan, but different from the 2011 learners.

Table 3. Treatment types in 2012

Group	English proficiency	Do they like learning English?	When and how to read chunk-by-chunk
D	High	No, but don't dislike it	read aloud in unison with the whole class after understanding a passage for 30 minutes per class
E	Not high	No, but don't dislike it	read aloud in unison with the whole class after understanding a passage for 30 minutes per class
F	Not high	Yes	read aloud in unison with the whole class after understanding a passage for 10 minutes per class
G	Not high	No, but don't dislike it	read silently in order to understand a passage for 10 minutes per class

All the groups in 2012 also increased their RE throughout the year, but the RE in groups F and G did not show an increase in WPM at the end. Instead, groups F and G showed improvement in their comprehension rate, which indicates that Mint training can enhance learners' overall reading ability, that is their RE, whether the factor contributing to RE is reading speed or reading accuracy.

A questionnaire-based analysis

Another study was conducted in 2012 (Yamaguchi, 2012) where a questionnaire was administered to group E mentioned above, who had low English proficiency but improved their WPM significantly during the four month training, in order to see changes in students' cognitive and mental attitudes toward reading. The questionnaire included 16 questions on a five-point Likert scale ('1: No', '2: Slightly no', '3: I'm not sure', '4: Slightly yes', and '5: Yes'). The question items were 'Are you a fast reader?', 'Do you pronounce English words in your head as you read?', 'Do you like reading in English?', 'Do you like English?', and so on. This study also had a pre- and post-design. A repeated *t* test was used for analysis. From the 16 items, 15 significantly changed their average. The only item that did not change statistically was that asking students if they had learned to listen to and understand spoken English. This indicates that the learners were aware that they had improved their WPM (#6 and #7), that they had learned not to read the same sentence repeatedly (#1 and #3), and that they were not so uncomfortable reading in English as they had been (#14). Table 4 shows the nine items that showed more than 0.5 effect size using Cohen's *d*.

Table 4. Significantly increased or decreased nine items of the questionnaire (more than 0.5 in *d*)

Item	M (Pre)	M (Post)	*t*	*d*
1. I understand passages when I read.	3.53	4.28	3.757	0.717
2. I pronounce the English words in my mind while reading.	3.68	4.28	3.376	0.578
3. I understand passages without translating each word into Japanese.	1.62	2.43	4.517	0.751
4. I can perceive the syntactic structure of a sentence while reading.	2.73	3.40	2.997	0.545
5. I read chunk by chunk while reading.	2.96	3.66	3.654	0.560
[a] 6. I'm a slow reader rather than a fast one.	3.85	3.04	4.602	0.703
7. I think I can read fast.	1.61	2.15	4.155	0.560
11. I'm good at finding a meaning unit.	1.83	2.57	5.054	0.761
[a] 14. I feel uneasy when reading.	4.43	3.70	4.992	0.711

Note: [a]*: significantly decreased item*

In this way, long years of our research and practice have shown that either silent or oral reading has, generally, had some effect on students' reading speed and efficiency as well as motivation (Yamaguchi, 2012; Yubune et al., 2009), excluding a transfer effect on listening ability.

Challenges

Despite these successful results, we perceived some challenges regarding how we had conducted the research. First, in the pre- and post-tests, we had difficulty measuring and collecting WPM and comprehension rates precisely; for example, we used multiple tools, such as HTML, a stopwatch, and an answer sheet. In one instance, without Mint, student subjects had to jot down their reading times on a tally sheet of paper after reading each passage. At other times, they had to mark an answer sheet for comprehension questions. Both these tools interrupted the reading and comprehension activity. Furthermore, these paper-based tests made it difficult to tally the data and provide quick feedback.

Another challenge was that the classroom practice differed in methods of implementation, as above, between the pre- and post-tests. In the silent reading group, as mentioned above, WPM data were measured by Mint, while reading scores to measure comprehension rates were displayed on and stored in Moodle. Students had to use different tools within a short time of rapid reading training. These separate tools also made it difficult to summarise and provide feedback on the data.

Yet another challenge is that more data are required to examine effects. The effect measurement for which we largely relied on pre- and post-tests should also have been obtained from the practice of every lesson in a classroom. As such, classroom practice

and pre- and post-tests need to be integrated. Thus, there arises a need to upgrade or renovate the software for more sustainable and effective practice.

Modified methodology

Renovated software

As a solution to the challenges above, Mint was replaced with Mewm (Mint Effective WPM Meter), software that was also developed by Mint Applications Co. LTD. The Mewm system has new quiz features enabling questionnaires with data encryption, which integrates fast reading practice, answering comprehension questions, and individual instant feedback into one platform, whether in classroom practice or pre- and post-tests. The system has two pieces of application software, Mewm and Mewm Pro, both of which run only on Windows® in a Japanese language environment. The former is used for learners to practice reading, and the latter for teachers to create reading quizzes and questionnaires. There are three steps for accurate and easy measurement: the creation of files, measurement of one learner's reading speed and accuracy, and the summarisation of all learners' data.

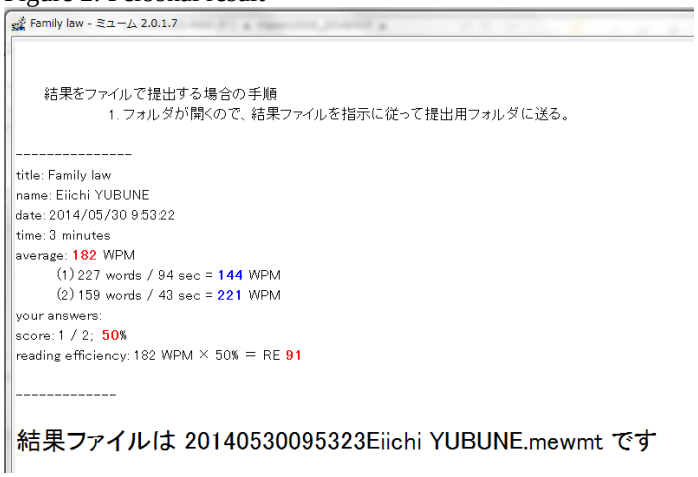
Step 1: creation of Mewm files

To create a Mewm file, teachers insert data (text or rich text files) of passages, questions, and answers into a newly created file to produce a Mewm file.

Step 2: measurement of learners' reading speed and accuracy

In the classroom, learners are given a Mewm file and the application Mewm.exe by their teachers, and drag it to the application to open a start screen. On this screen, they see basic precautions and instructions such as 'they will have to read both speedily and accurately'. They then enter their names, for example 'Eiichi YUBUNE', and the first passage appears. When they have finished reading, they click a button to start the comprehension quiz and the software records and corrects their answers. It also observes how long it has taken for learners to read a passage and answer the quizzes, respectively. When they have answered all questions, the reading activity ends and the screen displays learners' WPM and comprehension question results. The bottom line says, 'Your result file is 20140530095323Eiichi YUBUNE.mewmt' (Figure 2). At this stage, learners can reflect on their own skill of reading quickly and accurately. After that, they submit their file to the teachers. At this point of file submission, the Mewm system has a striking feature where the learners' data files automatically move to a specified shared folder on the intranet in the classroom. Incidentally, in the latest version of Mewm, their results are automatically summarised to show real-time class statistics (Figure 4).

Figure 2: Personal result



Step 3: summarisation of learners' data

Following the procedures outlined earlier, the final step is taken by teachers and researchers and involves collecting the files submitted by the learners.

When using Mint, teachers and researchers have had to repeat the following operation for each learner: open a learner file, copy the information, and paste the data into a spreadsheet. However, the Mewm software does not require such repetition. In this system, teachers merely select and drag all files into the Mewm Pro application, which then copies all data to the clipboard, for easy pasting into a spreadsheet (Figure 3). Figure 3 shows the summarised data of one reading activity including two passages and two comprehension questions. 'Wrd' stands for the number of words in one passage, 'rt' is the time spent on reading a passage, 'scr' means score. For example, learner D's WPM 1 (211.25) is calculated according to the formula: the number of words in passage 1 (169 words) divided by 'rt1' (48 seconds) times 60 equals 211.25.

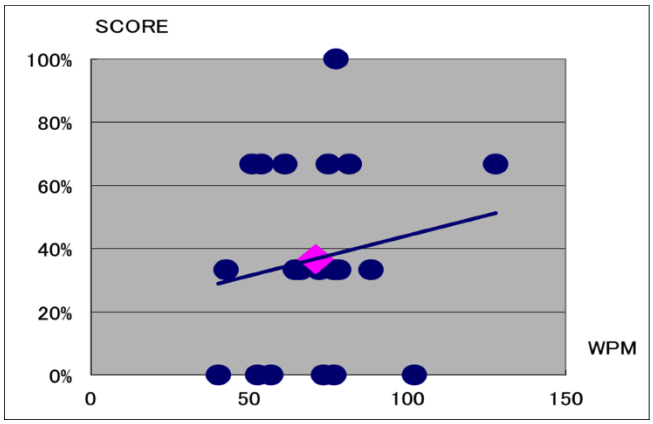
Figure 3. Automatically summarised data

	A	B	C	D	E	F	G	H	I	J	K	L	M	N
1	title	name	date	time	wrd1	wrd2	rt1	rt2	wpm1	wpm2	ans1	ans2	scr1	scr2
2	Intellectual property law1－1	A	2014/5/20 16:15	4.16	169	196	98	95	103.47	123.79	3	2	1	1
3	Intellectual property law1－1	B	2014/5/20 16:38	2.57	169	196	55	68	184.36	172.94	3	2	1	1
4	Intellectual property law1－1	C	2014/5/20 16:15	3.54	169	196	72	81	140.83	145.19	3	2	1	1
5	Intellectual property law1－1	D	2014/5/20 16:39	2.71	169	196	48	66	211.25	178.18	3	2	1	1
6	Intellectual property law1－1	E	2014/5/20 16:13	2.58	169	196	42	69	241.43	170.43	3	2	1	1
7	Intellectual property law1－1	F	2014/5/20 16:40	3.83	169	196	78	112	130	105	3	2	1	1
8	Intellectual property law1－1	G	2014/5/20 16:14	2	169	196	19	56	533.68	210	3	2	1	1
9	Intellectual property law1－1	H	2014/5/20 16:15	4.11	169	196	81	97	125.19	121.24	2	2	0	1
10	Intellectual property law1－1	I	2014/5/20 16:13	2.7	169	196	53	70	191.32	168	3	2	1	1
11	Intellectual property law1－1	J	2014/5/20 16:14	3.38	169	196	64	74	158.44	158.92	3	2	1	1
12	Intellectual property law1－1	K	2014/5/20 16:38	2.32	169	196	43	57	235.81	206.32	3	2	1	1
13	Intellectual property law1－1	L	2014/5/20 16:39	3.09	169	196	38	79	266.84	148.86	3	2	1	1
14	Intellectual property law1－1	M	2014/5/20 16:39	2.66	169	196	44	76	230.45	154.74	3	2	1	1
15	Intellectual property law1－1	N	2014/5/20 16:38	2.48	169	196	45	63	225.33	186.67	3	2	1	1
16	Intellectual property law1－1	O	2014/5/20 16:38	2.75	169	196	60	77	169	152.73	3	2	1	1
17	Intellectual property law1－1	P	2014/5/20 16:15	3.37	169	196	57	100	177.89	117.6	3	2	1	1
18	Intellectual property law1－1	Q	2014/5/20 16:39	3.24	169	196	62	93	163.55	126.45	3	2	1	1
19	Intellectual property law1－1	R	2014/5/20 16:15	4.05	169	196	78	86	130	136.74	2	2	0	1
20	Intellectual property law1－1	S	2014/5/20 16:39	3.14	169	196	55	77	184.36	152.73	3	2	1	1

Quick feedback of the tendency in class to learners

After automatically acquiring the summarised data from all learners, teachers can provide feedback on reading scores, WPMs, and REs in graph form by dragging and dropping the data onto a programmed spreadsheet that they have prepared for instant feedback (Figure 4). By doing this, they can make students aware of their performances each time, thus enabling them to self-adjust their reading speed and accuracy.

Figure 4: All learners' results at one time



Modified Methodology

This powerful feedback leading to students' motivation and self-adjustment of their reading and easy summarisation of their data caused us to modify our research methodology. First, in the classroom practice, we used Mint for phonological training as we had done previously, while using Mewm without its phonetic function for silent reading as a pacemaker or to provide feedback to make students aware of their reading for self-adjustment.

Second, in the pre- and post-tests, we encouraged students to read as many passages as possible within 15 minutes. Each passage has 100 to 150 words with just two comprehension questions. As the amount of reading could vary from student to student, this could encourage students to be more speed-oriented than they had been previously. Although the comprehension rate may take hold, reading speed would be expected to rise more.

Learners' response

As this was the first time Mewm was used in the actual classroom treatment, a preliminary questionnaire for further development of a tool to teach English reading was administered to learners who had undergone the four-month learning treatment using Mint and Mewm. This questionnaire comprised open-ended questions in which learners were asked to write down positive and negative points about using Mewm. The answers were categorised into four topics as outlined below.

Responses to instant feedback

In the questionnaire, some learners made some remarks about Mewm's feature of instant feedback about individual reading results of reading speed and rate. One student said that s/he could find their results about reading. Another said, '*I can read at my own pace. And I can find the results of my reading immediately after using Mewm'*. Both comments can be deemed positive.

Responses to displaying of chunked text

We could recognise the learners' awareness of chunked text. One learner said, *'I gradually learned not to go back to the first part of a sentence when reading'*. Another student said, *'I felt it was difficult for me to understand the main idea of a passage. That's because I cannot read a bigger chunk in the passage presented on a PC screen'*. These comments can depend on learners' reading strategies and/or their English proficiency. However, whether positive or negative, it is certain that they served our purpose of chunk reading, or, at least, became aware of chunked segmentation in understanding the context of a passage.

Responses to improvement in reading speed

We could also recognise various responses to the reading speed driven by Mewm. One learner said, *'Probably because Mewm helps me to read faster, I may have learned to read faster than before. Reading faster requires concentration. Thanks to the Mewm system, I've learned to concentrate on my reading'*. On the other hand, another student stated that s/he could not concentrate on reading since s/he felt as though s/he was being monitored while reading, since Mewm measures reading performance in the background. At least, this student seemed to have become keenly aware of the activity of reading itself.

Responses to instant feedback of the information about a whole class

The powerful feedback from the Mewm system, as mentioned previously, seemed to have a strong impact on the students. As one student noted, *'I was pleased to know other students' reading results'*. Knowing their own results in the context of the class seemed to help learners to reflect on their English reading. In particular, in a Japanese cultural background in which students tend to regard those around them to see how they are or should be, our students also wanted to know their place among their peers. Thus, based on students' feedback above, it can be construed that students were largely in favour of the software. This initial evaluation provides adequate preparation for further treatments in enhancing reading efficiency.

Conclusion and further challenges

Thus far, using a displaying mode of chunks on Mint, our surveys on learning effect and learners' psychological and cognitive aspects have shown, more or less, a favourable effect of chunk-based oral reading and fast reading on learners' reading efficiency as well as their motivation and reflection on their learning. On the other hand, Mewm has solved so many challenges of Mint in the process of practice and testing that it was possible to collect much more data from learners to clarify their performance, saving the time and energy of teachers and researchers in preparing files, implementing practice or tests, and summarising data.

On the learners' part, depending on how the software is used, it has the potential to become a more useful tool to improve reading on its integrative platform of training, feedback, testing, and eventually as a pacemaker. In addition, students became keenly aware of their reading and learning, which would have been impossible using a paper-based practice. These issues were made clear by the student responses.

The main challenge lies with how Mewm and Mint should be used. Appropriate length of a chunk and the reading ease of the passage should be considered. The learners' responses clearly showed that their learning style and proficiency vary. In the studies done so far, however, the length of a chunk was fixed by teachers, so that some students were reluctant to read the length of chunks provided. In general, higher proficiency students prefer longer chunks in order to read fast. The challenge is how to adjust the chunk length depending on learners' proficiency.

The familiarity and difficulty of a passage could vary substantially among students, which may warrant using an index of readability to measure reading ease in a passage. We may have to incorporate readability into our process of practice to test it in Mewm or Mint. To sum up, we should optimise the learning environment as much as possible for each individual learner and class.

The second challenge will be the long unsolved transference effect of reading on listening. While such transference has yet to be confirmed, increased phonological training in tandem with comprehensive powerful feedback and an adequate method of evaluation of oral reading may possibly reveal some likely connections. In light of these requirements, the number of classes suitable for this kind of practice needs to be increased. For example, we should set up a computer room environment with an intranet, develop an appropriate textbook to use for rapid reading in class, and also establish the integrity of the course and curriculum. Despite all these challenges, an optimised use of the chunk-reading application software can be said to create a unique approach towards developing skills in reading efficiently.

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