EFL Learners' Problem Solving While Writing: A Think-Aloud Protocol Study

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This paper highlights EFL writers' thinking process through think-aloud protocol analysis of 22 Japanese university students. The participants were asked to generate an idea of a novelty product and write a product proposal as they engaged in think-aloud. Out of 624 language-related episodes (LREs), 72% were meaning-based and 17% were grammatical episodes. With the help of dictionaries, 80% of noticed features were successfully solved. However, the analysis of LREs also revealed that (a) grammatical problems were less successfully solved (68%) and (b) learners frequently relied on L1-L2 translation, which led them to produce inappropriate expressions. For the learners to solve problems more successfully, this study leads to suggestions that: (a) learners cross-reference L2-L1 and L1-L2 dictionaries, (b) they learn to rephrase L1, and (c) they note what they felt was problematic, so that they can get feedback from the teacher.

本研究では、EFL学習者が英語を産出する際の思考過程を、22名の日本人大学生の思考発話プロトコル分析により明らかにした。学習者は、思考表出をしながら、自らの考えたアイデア商品を紹介するというライティングタスクを行った。総計624の言語に関連するエピソード（LREs）のうち、72%は自らの伝えたいことをどのように英語で表せばよいかについての発話（meaning-based）であり、17%は文法的項目に関する疑問を含む発話であった。辞書を使いながら8割の問題は自力で解決できたが、一方で（a）文法的問題の解決率が低い（68%）、（b）直訳に頼ることで誤りが起きやすいことも明らかになった。学習者が、より自力で解決する力をつけるために、また教師等からフィードバックを得られるよう、（a）和英で知り得た情報を基に英和辞書をさらに参照する、（b）母語を第二言語に変換しやすい形の易しい母語構造に言い換える工夫をする、（c）問題点に関する気づきを書き留める等の指導が有効であると提案する。

A growing number of studies have offered the evidence that L2 output has positive effects on language learning. In Swain's Output Hypothesis (1985, 1995), she proposed that learners' production of their L2 has at least three functions: the noticing function, the hypothesis testing function, and the metalinguistic function. In one of the pioneering output studies, Swain and Lapkin (1995) investigated L2 learners' writing process using think-aloud protocols. Nine young adolescent students' protocols revealed that learners noticed what they did not know, reflected upon their own internal knowledge, and tried to solve linguistic problems without external resources. The results also suggested that the learners' hypotheses were sometimes faulty, leading to an unsuccessful outcome.

Subsequent studies examined L2 learners' noticing and problem solving while writing. Coyle and Roca de Larios (2014) examined what EFL learners noticed in a joint story-writing task. When 23 child pairs noted down whatever they felt was problematic, it was revealed that lexical problems were the most frequent (91%) among the four categories of lexis, spelling, grammar, and ideas and expression. Qi and Lapkin (2001) investigated two ESL learners' think-aloud protocols while they engaged in a picture description task. The learner with a high-intermediate level solved two thirds of the problems, but the learner with a low-intermediate level was able to solve only one fourth. Yang and Zhang (2010) investigated university students' noticing in a picture description task. They recorded discussion of five pairs and reported that the students focused on lexical problems most frequently (51%), followed by grammatical problems (40%). Similar to the results reported by Qi and Lapkin, the solution of their discussions turned out to be incorrect 38% of the time and some problems were avoided (9%).

In most of these previous studies, learners worked on a task in an output-only writing condition (Qi & Lapkin, 2001), where no external resources were available. However, in everyday writing situations, learners resort not only to their own internal resources (i.e., their interlanguage) but also to external resources (e.g., dictionaries) to solve linguistic problems they have noticed. The present research was focused on what learners notice and how they solve problems in a similar situation, with the use of dictionaries, as they work on writing tasks. In addition, previous studies have not articulated the kinds of

problems learners noticed but failed to solve. Therefore, the research questions were set as follows:

- RQ1. What problems do Japanese learners of L2 English notice in a writing task?
- RQ2. To what extent do they successfully solve the problems they have noticed?
- RQ3. What are the factors of the problems they failed to solve?

Method
Participants

The participants were 22 first-year students at a university of economics in Japan. They were 13 men and 9 women, who were recruited from 72 students in three of my compulsory English classes. During the previous semester, they had engaged in a writing assignment that was similar to the task in this study. I selected the participants according to the number of global errors they had made in the earlier assignment. Global errors are those errors "that interfere with the comprehensibility of a text" (Burt & Kiparsky, 1972, cited in Ferris, 2002, p. 35). Only learners who had produced not more than one global error were chosen. When I conducted the pilot study, some sentences with global errors were incomprehensible and I was unable to address the error types. I concluded that excluding writers with any global errors would be better, in pursuit of the aim of the study. However, there were only 10 students with no global errors at all. Because the number was so small, I decided to ease the condition and recruit students who made only one global error. The 22 chosen participants had TOEIC scores ranging from 380 to 475, averaging 418; the test was taken before this study started..

Data Elicitation

In investigating learners' cognitive processes, previous studies have employed various online and offline measures such as think-aloud protocols (also used in this study), note-taking, stimulated recall, or underlining. In think-aloud, learners are asked to verbalize what they think while they engage in problem-solving activities or language tasks (Ericsson & Simon, 1993). The potential risk is that the act of think-aloud itself functions as an additional burden on learners (Bosher, 1998), which might alter their mental processes. However, the think-aloud is advantageous in that the absence of a time lag minimizes memory decay. In other words, the nature of concurrency enables researchers to tap into the information while it is still in the learners' working memory.

Procedure

I first explained the task conditions:

1. Participants would verbalize whatever came to mind while writing.
2. All the verbalization would be audio recorded and the screen of the electric dictionary would be video recorded.
3. They would be paid 1,200 yen per hour.

Lastly it was also added that there was no time limit and dictionaries would be available, so they could feel relaxed, just as if they were writing at home. After the participants agreed to the task conditions and signed the consent forms, they read the task in Japanese:

> You are working for a company that sells novel and useful products. However, your company's performance has slumped recently. In order to save the company, please come up with an original product and give a product description.

All participants were familiar with the task because it had been part of their assignments in the previous semester. One week before the task they were asked to come up with another idea but not to prepare anything in English so that all the thinking process would be recorded during the task session.

The task was administered in a quiet room on an individual basis. After participants had practiced think-aloud for 5 minutes on a different topic, they began to write about their original product as they engaged in think-aloud. After the task, each text was read carefully by two readers. Because my own L1 is Japanese, I asked one native speaker of English to also read the texts, so that a target language norm would be reflected in error identification. We read the texts together, identified errors, and discussed into which category each error fell: lexis, grammar, orthography, or discourse. Three categories (i.e., lexis, form [grammar], and discourse) were those used by Qi and Lapkin (2001). However, as the learners' focus was sometimes broader than lexis (e.g., collocational or phrasal choice), I interpreted the lexis category as *meaning-based* (see Abadikhah, 2011), used when they focused on any semantic component of the language. Also, as they sometimes talked about problems concerning spelling, the category of orthographic episodes (Abadikhah, 2011) was added.

Language-Related Episodes

In order to identify language-related episodes (LREs), all the verbalizations were transcribed. LREs are defined as "any segment of the protocol in which a learner . . . spoke

about a language problem he/she encountered while writing" (Swain, 1995, p. 130). Based on this definition, LREs were identified and sorted into the four linguistic categories. The other reader and I then decided if the problem was successfully solved or not. To decide this, we followed Swain's (1998) principle, which stated that the focus should be placed on the exact aspect of language about which the learner had spoken. For instance, when a learner focused on the grammatical aspect and the output contained an orthographic error, the LRE was evaluated as successful as long as the syntactic problem was successfully solved. By adapting this criterion, the analysis was fine-tuned to the learners' focus as much as possible. Because other researchers were unavailable, I coded all the protocols twice. The coding was done at 5-month intervals. The consistency of the coding was checked by calculating the intracoder reliability coefficients. The reliability was 0.95.

Following are definitions and protocol examples of the four categories of episodes. All the participants thought aloud in their L1 (their own choice), so the protocols have been translated into English as necessary.

Meaning-Based Episodes

These included utterances concerning semantic components of the language (e.g., a lexical, collocational, or phrasal search)

[successful]

So, I, *hatsumei suru* [invent]. *Introduce. I introduce*. Is it correct? *Introduce*. (dictionary use [hereinafter abbreviated as dic]: *dounyu suru*) Was that *invent*, maybe? *Invent* (dic: invent), yeah it's *invent.*

[unsuccessful]

Oto ga chiisai [The volume is low]. *Shou on* [low volume]. (dic: *shou on*: no results) (dic: *chiisai*) *Small.*

In the successful episode, the participant intended to write *hatsumei-suru* [invent] but the word *introduce* popped into his mind. However, he gradually became unsure and checked his dictionary, which let him notice that he had mistaken *introduce* for *invent*. In the unsuccessful episode, the participant noticed he did not know how to express *Oto ga chiisai* [The volume is low]. In the L1-L2 dictionary he looked up *chiisai* and found *small*, and decided to write *The volume is small*. Although the expression is understandable, I decided the episode was unsuccessful because his focus was on lexical choice and he

failed to choose the expression *low* despite the sample sentence *talk in a low voice* having appeared in the dictionary.

Form Episodes (Grammar)

Utterances regarding syntactic and morphological features of the language (e.g., verb form, agreement, word order) were classified as form (grammatical) episodes.

[successful]

Should I put *a* before money? I remember that money is…(dic: money) Well, coun… uncountable. I can't put *a* because money is uncountable.

[unsuccessful]

Moji o kaku toki. Muji no kami ni [When you write characters on a sheet of plain paper]. Should it be *on*, or *in*? Wait, I may not need any preposition here. (In the dictionary she finds a sample sentence *Write your name and address here.*) *Koko ni* [here], no prepositions. I may not need it. When you write…, but still I feel like putting something. Oh well, let's go without it. (She writes *write a character a paper…*)

The first participant was unsure if an article is necessary before *money*. Knowing that uncountable nouns do not require an article, he concluded that an article is unnecessary. In the second example, the participant wondered which preposition to use between *write* and *paper*. She looked it up, but the example had *here*. Not knowing *here* does not require a preposition as it is an adverb, she decided that *paper* does not require a preposition, which is ungrammatical.

Orthographic Episodes

In the orthographic episodes, participants talked about problems regarding spelling or punctuation.

[successful]

Small. Wait, was that *smoll*, or *small*? Uh-oh, I forgot. (dic: *chiisai* [small])

Almost all the orthographic episodes were concerning spelling. They simply checked it in L1-L2 or L2-L1 dictionaries and produced the correct forms.

Discourse Episodes

These were any utterance in which the participants tried to achieve logic sequencing or inter-sentential clarity.

[successful]

(After writing *The appearance of the product* is…) I don't feel like using *of the product* once again. Should I write *of this* or *of it* instead? Well, I'd rather not write anything at all. Readers can tell. (He deletes *of the product*)

[unsuccessful]

Nedan [price]. The price of… Well, let's not use *this product.* I'll change all the *this product* into *it.* (He writes "The price *of it*…" and "The size *of it*…")

In most of the discourse episodes, the problem that the participants talked about was that the same expression appeared several times in their texts. The first learner decided to delete the redundant part, correctly judging that the deletion would not affect the reader's understanding. The second participant, however, decided to solve the problem by altering all the nouns to pronouns, which the native-speaking reader considered incorrect.

Results

In an analysis of 14.5 hours of think-aloud protocol data of 22 participants, a total of 624 LREs were identified, averaging 28 episodes per person. On average, they wrote 97 words in 39 minutes. As shown in Table 1, most of the LREs were meaning-based (72%). The second most frequent category was form (grammatical), at 17%. Participants seldom talked about orthographic (5%) or discourse (4%) episodes.

Out of all 608 LREs, 80% (486) were successfully solved. Although the success rates of meaning-based (81%), discourse (81%), and orthographic episodes (97%) were more than 80%, the form (grammatical) problems were less successfully solved (68%).

In total, 122 problems turned out to be either unsuccessful or avoided. The analysis of these protocols found certain characteristics.

Table 1. LREs in the Four Linguistic Categories (*N* = 22)

Category	Count	Percentage
Meaning-based	447	72%
Form (grammatical)	104	17%
Orthographic	31	5%
Discourse	26	4%
NA (too vague)	16	3%
Total	624	100%

Table 2 shows the LREs broken down into the four linguistic categories.

Table 2: Successful/Unsuccessful LREs in the Four Linguistic Categories (*N* = 22)

Result	Meaning-based	Form	Orthographic	Discourse	Total
Successful	365	70	30	21	486
Unsuccessful	61	29	1	5	96
Avoidance	22	4	0	0	26
Total	448	103	31	26	608

Inadequate Mastery of Grammatical Knowledge

As dictionaries do not always provide explicit grammatical information, participants mostly had to solve grammatical problems by analyzing sample expressions in the dictionary and forming hypotheses. When they had the expression they wanted to use partially in mind, they successfully solved the form-LREs by entering key words to find similar expressions in the dictionary:

Example 1: *Have you ever*. This is present perfect and interrogative sentence. What form should come next? (dic: have&you&ever: *Have you ever broken any traffic rules?*) Okay, I can use the perfect form in an interrogative sentence, too.

Example 2:   *You don't need…* Was that *need to*, or *need –ing*? (dic: need) Well, *need to* is correct.

However, when they did not know what form they should use, they had to rely solely on their own knowledge.

Example 3:   Can I make a sentence like *SV, SV*?

Example 4:   *Blue, yellow, black, white…* I don't remember how to connect these nouns.

Example 5:   *When you ride on a train… you become sleepy.* Oh wait. It should be interrogative. No wait. I should leave it as it is. Well, what should I do?

In the same way, they ended up producing incorrect output when they omitted the step of using dictionaries.

Example 6:   *Every morning. In the morning.* Should *every morning* come with *in the*? (She decided to write *in the every morning* without checking it in the dictionary.)

Although the participants' focus was on the form, they failed to find a correct solution because of inadequate mastery of the grammatical knowledge thereof.

Synonym Misanalysis

Meaning-based LREs were characterized by a sequence of three components: L1 utterance of an expression they wanted to know, use of an L1-L2 dictionary, and utterance of L2 search results. This is shown below.

L1 utterance:	*Oto ga chiisai.*
L1-L2 dictionary use:	(dic: *shou-on*) (dic: *chiisai*)
Reading L2 entries in the dictionary:	*Small*

Using a combination of dictionaries and their existing knowledge, participants mostly succeeded in finding lexical items that have one-to-one correspondence equivalents, such as *sentaku ki* [washing machine], *hatsumei suru* [invent], and *shikakui* [square]. However, participants sometimes chose contextually inappropriate expressions when there were multiple L2 entries in the dictionary.

Example 7:   L1: *Nama gomi o <u>tsuchi</u> ni <u>kaeru</u>*
L2: *<u>change</u> raw garbage into *<u>earth</u> (Correct: <u>convert</u> raw garbage into <u>soil</u>)

Example 8:   L1: *Heya ga <u>akaruku</u> naru*
L2: The room becomes *<u>light</u> (Correct: The room becomes <u>bright</u>)

Example 9:   L1: *Taiyou no hikari <u>ni yotte</u> mezameru*
L2: wake up *<u>by</u> sunlight (Correct: wake up <u>with</u> sunlight)

In Example 7, the participant asked, "Is 'change' really all right?" She also asked herself, "Can I use 'earth'? It reminds me of *chikyuu* [globe]," but did not check the L2-L1 dictionary for more detailed information. Without referring to an L2-L1 dictionary, participants sometimes chose an incorrect lexical item simply because it sounded right or was more familiar than other expressions.

Conjunctive/Modifying Expressions

It was easier for the participants to express tangible objects or actions that are realized as nouns or verbs, but they struggled to express connecting or modifying expressions, which are often realized as conjunctions or collocations that involve adjectives, adverbs, or prepositions.

Example 10:   L1: *Hoshita <u>mama</u> gaishutsu suru*
L2: *<u>When</u> you go out, have you hung out… (Correct: hung out <u>and</u> go out)

Example 11:   L1: *<u>Choudo</u> no kingaku*
L2: *<u>just</u> money (Correct: <u>the exact amount of</u> money)

Example 12:   L1: *Size <u>ni yotte</u> wakeru*
L2: separate *<u>from</u> size (Correct: separate <u>according to</u> size)

Sometimes, they gave up conveying the whole idea as in Example 13. Unlike nouns or verbs, direct translation of these L1 expressions does not always work.

Example 13: I want to explain where the switch is, but I don't know how to say...
(Avoided)

L1 Transfer of Wa-Desu Structures

This involves interlingual errors at the structure level caused by direct translation. At a very early stage of English learning, Japanese students often learn sentences with *be*-verbs such as *This* [noun A] *is a pen* [noun B] as equivalents of *wa-desu* structures like *Kore* [noun A] *wa pen* [noun B] *desu.* However, this direct transfer does not always produce correct L2 outcome. The following examples are sentences the participants incorrectly produced in the task:

Example 14: L1: *Color variation / wa / itsutsu / desu.*

L2: *A color variety is five. (Correct: There are five colors.)

Example 15: L1: *Shiyou houhou / wa / kantan / desu.*

L2: *Direction is easy. (Correct: It is easy to use.)

Example 16: L1: *Shouhin no katachi / wa / shikaku / desu.*

L2: *The product's form is square. (Correct: The product is square.)

Although some of these sentences sometimes seem free from grammatical errors, the native-speaking reader judged them to be incorrect because those forms would not be used in English to express the specific ideas that the students had for their products. Despite the fact that *Noun + wa* is not always compatible with *Subject + be-verb*, they tended to transfer the L1 structure to the L2.

Discussion

The participants' protocols revealed that the L2 writers focused on meaning-based problems most frequently, which was similar to the findings of previous studies (e.g., Coyle & Roca de Larios, 2014; Qi & Lapkin, 2001). The fact that they mostly focused on semantic components of their L2 coincides with Hanaoka's (2012) statement that "Learners process output for meaning before they process it for form" (p. 135). Although

two ESL learners in Qi and Lapkin's study (2001) successfully solved half of the problems, the participants in the present study solved four out of five episodes successfully, which indicates that dictionaries serve as effective external resources in solving problems. It is also notable that grammatical problems were less successfully solved than other categories. This may be because dictionaries do not always provide explicit information for the grammatical problems learners face, such as how to connect words or what verb form to use in what context.

The exploratory error analysis also revealed that participants tended to rely on L1-L2 translation. Although L1-L2 dictionaries provide orthographic information and offer abundant L2 entries in various possible contexts, the participants sometimes seemed confused and buried in input that was too rich. When the participants' focus was directed toward lexical searches, they ended up using more familiar words or following their own intuition. However, if they had gone further, opened up the L2-L1 dictionary, and tried to compare the usage of the possible applicable words, the results might have been different. One of the pedagogical implications, therefore, is that teachers should encourage learners to cross-reference L1-L2 and L2-L1 dictionaries. At the point when they need a certain lexical item, it is highly likely that their *cognitive window* (Doughty, 2001) is open and they have an opportunity to focus on subtle differences between these lexical items. Errors caused by L1-L2 translation were also observed at both a phrasal and a sentential level. In particular, the *wa-desu* structure led learners to produce awkward sentences. Therefore, another pedagogical implication is that teachers should encourage learners to understand that sentence structures are not always interchangeable between languages.

Although it is imperative for learners to be free from negative L1 influence, writing completely without L1 seems unrealistic and sometimes impractical. To address this problem, Yoshida and Yanase (2003) suggested that learners develop their ability to convert *J1* to *J2*. Here J1 is original Japanese and J2 is rephrased Japanese that is easier to then translate into L2. For instance, if an original message is *hoshita mama gaishutsu suru,* the learner can rephrase it in Japanese to *hoshite kara gaishutsu suru,* which holds the same message and is easier to express in L2, *hang out and go out.*

Conclusion

The present study has confirmed evidence that learners notice various aspects of language in the course of writing. Learners mainly write for meaning, only sometimes shifting their focus to form. The think-aloud protocols revealed that learners were able to solve their linguistic problems with the aid of a combination of dictionaries and internal

resources. However, as Qi and Lapkin (2001) indicated, the outcome was not always successful, especially in grammatical aspects. This is where pedagogical interventions would be most beneficial because it is the point at which the learners' sense of problematicity is most highlighted and they are ready to receive relevant input. If learners face problems at times when teachers' feedback is unavailable, one solution may be that they note down what they felt problematic so that they can keep a record of noticing and get later feedback.

Although this research fulfilled its aims, there are some limitations to be considered. First, the sample size was relatively small and the findings may not be representative of general EFL learners. Second, the study excluded less proficient writers who sometimes produce incomprehensible texts. Further consideration is necessary to determine how those learners can solve the problems more successfully and produce comprehensible output. Third, although the study aimed to explore EFL learners' mental processes in an everyday writing situation, the participants might have executed the task in a different psychological situation in that they had the researcher in the same room, their verbalization was recorded, and they were paid for the task. The possibility cannot be denied that these conditions set them to work more seriously and with more tension. Although these conditions were necessary to capture the learners' mental processes in detail, it would also be beneficial to observe what kind of other resources they utilize (such as friends, grammar reference books, or Internet sites) when they are in a truly natural setting.

Bio Data

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