

ARTICLE



## A reflective e-learning approach for reading, thinking, and behavioral engagement

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### Abstract

*One of the main goals of the English as a Foreign Language (EFL) course is to facilitate the development of learners' reading comprehension and reflective skills in English, which can be developed with appropriate instruction. However, in EFL courses, many students are inactive in reflecting on their reading and are disengaged from learning. To fill this gap, a reflective reading-based e-learning approach was proposed to explore the impact of the suggested approach on reading comprehension, reflective thinking, and behavioral engagement. The study aimed to improve the comprehension of the student's reading using the proposed reflective e-learning approach. The study employed a quasi-experimental design in which the experimental group used reflective reading-based e-learning ( $n = 51$ ) and the control group used conventional e-learning ( $n = 50$ ) for a total of 13 weeks of participation. The experiment was designed to examine reading comprehension, reflective thinking, and behavioral engagement (e.g., reading time, Marker list, Quiz score, Memo list). The results revealed that the reflective reading-based e-learning approach could improve the comprehension and reflective thinking of the learners and promote behavioral engagement. These findings can be valuable for educators designing strategies to improve students' reading comprehension skills and stimulate behavioral engagement in e-learning systems.*

**Keywords:** *Reflective E-learning Approach, Thinking, Behavioral Engagement, Reflective Thinking Skills*

**Language(s) Learned in This Study:** *English*

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### Introduction

Cultivating higher-order thinking, including reflective thinking, among English as a foreign language (EFL) learners has been recognized as an important educational goal (Apsari, 2018; Zhang, 2018). However, in traditional EFL instruction, students rely heavily on the knowledge and translation imparted by the instructor (Fauzan & Ngabut, 2018; McNamara & Kendeou, 2011), and there is little focus on developing higher-order thinking skills (Vaseghi et al., 2012). A technology-enriched classroom environment might positively affect learners' acquisition of higher-order thinking skills (Baguma et al., 2019; Supriyatno et al., 2020; Yaniawati, 2013). In light of this, e-learning was adopted, which generally refers to the use of technological devices for learning purposes (Bai & Wang, 2021). Researchers have indicated that e-learning not only enables students to have flexibility and the opportunity to learn creatively in comprehending the material, but also that it allows learning to take place with the help of technology through computer equipment (Bai & Wang, 2021; Sakkir et al., 2021; Zhao et al., 2021). A systematic review of the literature conducted by Awan et al. (2021) described the benefits of adopting e-learning systems and strategies for implementing e-learning in higher education institutions and further showed that e-learning enabled teachers to design better curricula and involve students in class, which could promote active learning and positively impact their academic performance.

On the other hand, scholars have stressed that incorporating appropriate learning strategies into e-learning is crucial to strengthening student reflection (Apsari, 2018; Karabuga & Kaya, 2013; Zhang, 2018). However, it is important to provide the necessary tasks when reading to enable learners to reflect effectively. Reflective reading exercises have been mentioned to motivate learners to read regularly and also improve their understanding of the content and promote the development of learners' monitoring, reflective thinking skills, and self-evaluation (Apsari, 2018; Karabuga & Kaya, 2013; Zhang, 2018). Some scholars suggested that learners could summarize the main ideas from their readings and write about their understanding and feelings (Nourdad & Asghari, 2017). In this manner, reflective reading encourages learners to confirm their understanding of what they have learned and to generate their ideas, reflections, and applications.

In previous research, various experiments have been conducted to involve learners in a range of student-centered learning environments that provide learners with sufficient time to read and reflect on their learning (Kim & Hannafin, 2011; Pedersen & Liu, 2003). Most reflective reading strategies include writing insights, reports, and thinking aloud, which are ways to help learners better understand the text through reflective reading (Lew & Schmidt, 2011; Nourdad & Asghari, 2017).

Despite the numerous benefits of reflective reading identified in conventional teaching and the excellent performance of e-learning, the question of how to persuade more learners to engage in e-learning remains (Bai & Wang, 2021; Zhao et al., 2021). Behavioral engagement is the variable in all conceptualizations of engagement (Bråten et al., 2021). Following Li et al. (2021), behavioral engagement is conceptualized as collectible and analytical engagement with the reading task. That is, as the total read time, the total words marked, and the total words written directly from the learning record being stored. More specifically, behavioral engagement has been defined as active and observable participation of the learner in reading tasks, as evidenced by time, effort, and productivity (Bråten et al., 2021; Chen et al., 2021; Li et al., 2021). However, little previous research has focused on analyzing the relationship between learning comprehension, reflective thinking, and behavioral engagement (Boticki et al., 2019; Chen et al., 2021). Therefore, this study addressed the lack of previous research by adopting a reflective reading-based e-learning approach that can support and enhance learners' learning in the e-learning system and further investigate the behavioral engagement that influences their reading comprehension and reflective thinking.

An attempt was made to compare the reflective reading-based e-learning approach with the conventional e-learning approach and to evaluate it to develop reading comprehension, reflective thinking, and behavioral engagement. For these purposes, the following research questions were framed.

1. What is the effect of using a proposed reflective e-learning approach on participants' reading comprehension, reflective thinking, and behavioral engagement?
2. Is there a statistically significant difference between the mean scores of the experimental and control group learners on the reading comprehension tests?
3. Is there a statistically significant difference between the mean scores of the experimental and control group learners on the reflective thinking questionnaire?
4. Is there a statistically significant difference between the mean scores of the experimental and control group learners in the behavioral engagement records?

## Literature Review

### Behavioral Engagement in Reading

Engagement is defined as the sustained effort and focus on learning activities to achieve a stated learning goal (Bråten et al., 2021; Wan Yusoff, 2018). List and Alexander (2017) mentioned that reading a text requires cognitive effort, and deeper engagement may help construct a complete mental map of the text. Engagement covers the extent to which learners actively participate in learning activities (Bikowski & Casal, 2018; Bråten et al., 2021; Li et al., 2021; Lin et al., 2021) and involves behavioral, affective, and cognitive aspects (Abou-Khalil et al., 2021; Bråten et al., 2021). Behavioral engagement is a variable in all conceptualizations of engagement (Bråten et al., 2021). More specifically, behavioral engagement is

defined as the active participation of learners in the reading task, specifically in terms of time, effort, and efficiency (Bråten et al., 2021; Li et al., 2021). Behavioral engagement is related to learner performance (Chen et al., 2020; Junco & Clem, 2015). Focusing on digital texts with higher levels of behavioral engagement may be associated with improved reading comprehension (Karahan, 2017; Kim et al., 2021). These results highlight the importance of supporting the behavior of learners in the context of EFL reading comprehension.

### **Behavioral Engagement in E-Learning**

Most previous studies refer to e-learning definitions that involve the use of technology for learning purposes, knowledge, and skill development (Awan et al., 2021; Bai & Wang, 2021; Zhao et al., 2021), while only a few definitions cover important aspects of the concept of e-learning, such as distributed, flexible, anytime, and interactive (Choudhury & Pattnaik, 2020). In other words, e-learning enables learners to learn as they need to, without time and space constraints. (Veletsianos & Houlden, 2019; Yates et al., 2021). The e-learning system presents text and images and has different features to help learners read and learn and supports teachers in monitoring learners' learning (Akçapinar et al., 2020; Chen et al., 2020; Li et al., 2021). Behavioral engagement can be observable with the help of e-learning systems that facilitate the measurement and collection of learners' learning behavior records (de Brito Lima et al., 2021; Chen et al., 2020). Therefore, e-learning systems provide more than just e-learning materials; they also have features and functions that support learners in taking notes and marking the content. With the support of an e-learning system, it would be easier to follow the work and monitor their progress. Therefore, the efforts they put into learning and their performance in learning can be identified more precisely. For example, the study by Junco and Clem (2015) indicated that the length of time spent reading is one of the fundamental variables that predicts academic outcomes. Chen et al. (2020) found that a topic scanning instruction technique in an e-learning environment increased the efficacy of learners' reading comprehension. However, few studies have used learners' learning records in e-learning systems to examine learners' behavioral engagement, let alone using learning records to examine the effects of e-learning systems on learners' behavioral engagement and reflective skills. It would be beneficial to design an e-learning activity that promotes reflection and analyzes the effects of this approach. Specifically, this approach encourages reflection on the understanding of the text of each unit as learners establish connections with the course materials by doing the learning activities in the e-learning system. In this study, behavioral engagement was collected and analyzed directly from the total time learners spent reading (Reading time), the total number of times marked in reading (Marker list), response to reading questions (Quiz score), and the total number of words written on reflective memo (Memo list) as obtained from the e-learning system records.

### **The Importance of Reflective Thinking Skills**

Developing reflective thinking skills should be an important part of the reading curriculum (Chittooran, 2015). Reflective thinking emphasizes reflection and regulation based on certain criteria and understanding of the context in the text. Kember and his colleagues (2000) provided a prominent and detailed questionnaire for assessing different levels of reflective thinking. The questionnaire consists of four constructs: habitual action, understanding, reflection, and critical reflection. Habitual action refers to the tendency of individuals to repeat past behaviors that lead to desired outcomes, while understanding refers to the comprehension of the text by learners (Dezfouli & Balleine, 2013). Finally, reflection and critical reflection improve learning by allowing learners to articulate and codify their experiences (Di Stefano et al., 2014).

Reflections while reading can facilitate the development of higher-order thinking (Boutet et al., 2017). Learners can relate to their prior knowledge and build new concepts through reflection. During the reading process, learners monitor their comprehension. As a result, it improves the awareness of their thinking processes. If learners are curious about their learning, they will consider how to translate the textbook's content into their ideas. It is a learning opportunity for them to get back to the center of the learning process themselves. Promoting the development of reflective thinking requires appropriate methods, contexts, and techniques for reflective reading training.

Moghaddam et al. (2020) mentioned that reading skills in a language could also be improved through different reflective activities. Jahandar et al. (2012) conducted an experiment that applied reflective writing to a foreign language reading class. The results found a significant increase in the mean score of the experimental group, suggesting that reflective thinking is beneficial in improving the comprehension of learners' reading. Empirical research has recognized the benefits of incorporating reflection skills into foreign language learning (Genç, 2017). More importantly, research points to reflective thinking as a higher-order skill associated with learners' academic achievement (Demirel et al., 2015).

### **Reflective Reading**

The connection between reflective thinking and reflective reading prompts reflection to become increasingly critical in the EFL classroom, as learners are required to explain key concepts in the reading and reflect on their application by reflective reading. Scholars have demonstrated that reflective reading is one of the important reading strategies that can help learners acquire EFL language skills (Apsari, 2018; Nourdad & Asghari, 2017). Reflective reading should be practiced so that EFL learners can develop the skills to process their learning experiences mentally, identify what they have learned, modify their understanding in light of new information and experiences, and transfer their learning to other situations. Rostami and Fatehi (2021) found that learners performed better in reading comprehension when practicing journal writing. Chittooran (2015) suggests considering using reflective journals or videos to promote reflective reading. However, if teachers only concentrate on covering textbook content in class and assume that learners know how to engage in learning, this is not practical. Therefore, this study has provided an explicit reflective thinking procedure to encourage learners to be more engaged in their reading, thus improving their comprehension.

With the development of technology, the engagement of the learner and reading processes can be recorded and analyzed (Akçapınar et al., 2020; Boticki et al., 2019; Li et al., 2021; Majumdar et al., 2021). Today, e-learning systems have been developed to record learners' learning so that their reading behaviors can be monitored, and the potential benefits of using e-learning systems to support the reflective process are important in facilitating deep learning (Sims & Bovard, 2004). For example, Li et al. (2021) and Boticki et al. (2019) demonstrated that e-learning systems could advance reading to visualizing and analyzing learning behaviors. In addition, studies by Majumdar et al. (2021) illustrated that e-learning systems incorporate learning strategies that can provide a supportive e-learning reading environment for learners to implement reading activities effectively and provide instructors with the means to monitor learners' reading learning status. Writing reflections in language classes have been designed to allow learners to make informed comments about the ideas presented in the text and to help them use the language they are learning. However, despite the great advantages and excellent performance of e-learning, it remains a problem to convince more learners to engage in e-learning. As Boticki et al. (2019) and Chen et al. (2021) suggested, since reading comprehension is one of the most complex cognitive activities humans engage in, more research is required to clarify the relationship between reading comprehension, reflective thinking, and behavioral engagement.

### **Reflective Reading-Based E-Learning**

Reflective reading and writing practice are often used for self-improvement in educational and professional settings. Schön (1987) stated that reflective reading adopts critical self-analysis in which individuals consider their own experiences in applying knowledge to practice. Therefore, the present study utilized this productive process by specifically incorporating reading strategies to encourage self-awareness. These steps serve as a framework for positive reading changes in the educational context (Schön, 1983). This study's reflective reading-based e-learning approach was designed to highlight guided reading in an e-learning system by following Chen et al.'s (2021) reading engagement-promotion strategy (i.e., Scan, Question, Read, Reply, and Reflect) to serve as an instructional framework. According to the reading engagement-promotion strategy, e-learning tasks were designed as follows: Participants first scanned (Scan) for the main ideas and used the marker function to highlight the important ideas. Then, they could read the questions (Question) that the teacher had prepared, and they read (Read) the text to find the answers and then reply

(Reply) to the questions in the quiz function. The memo feature indicated sections where learners could make their reflective annotations (Reflect) at the page level in the e-learning system. This is intended to improve learners' reading comprehension, reflective thinking, and behavioral engagement. This framework for the reading engagement-promotion strategy was adopted to design the reflective e-learning approach to reading.

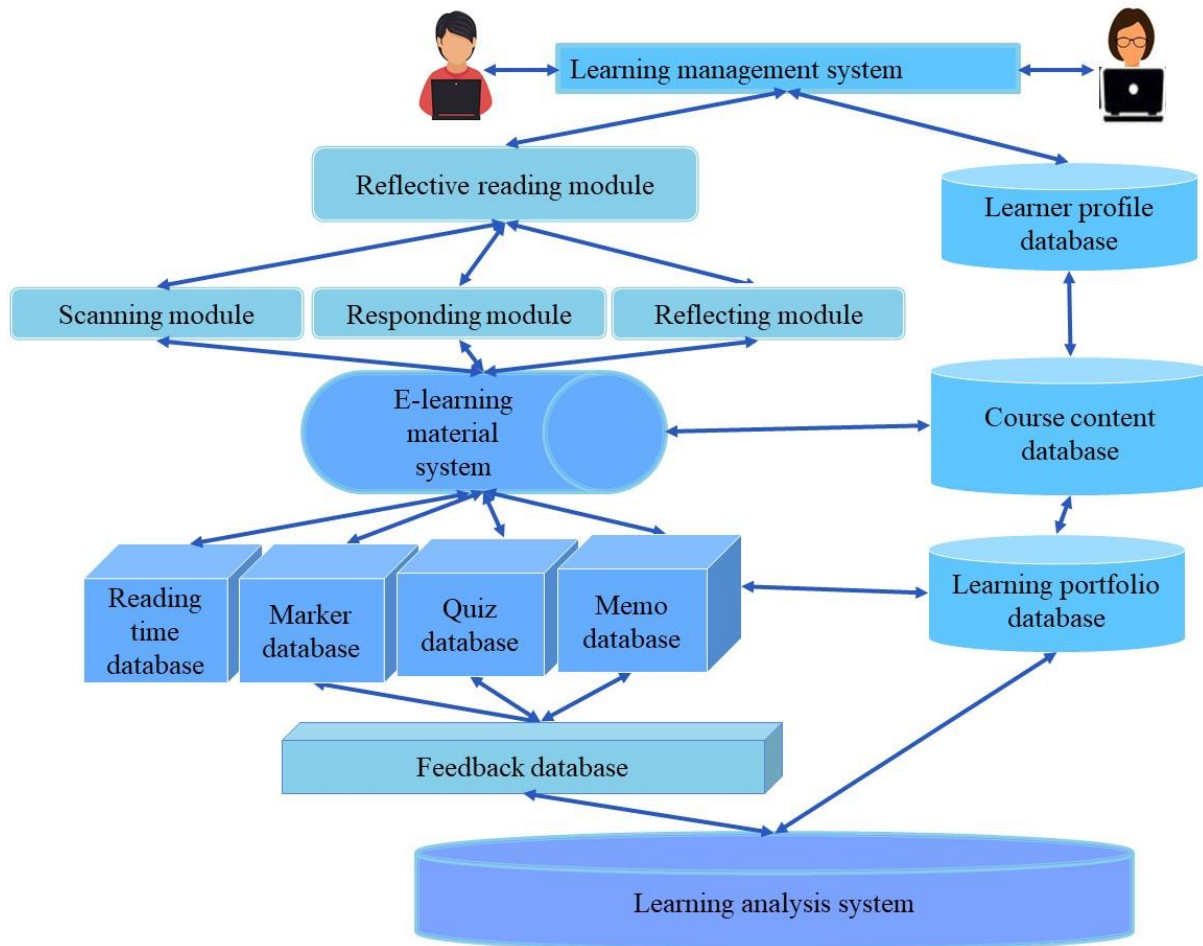
### **E-Learning System Framework**

The present study developed and applied a reflective reading-based e-learning system to English e-learning tasks. [Figure 1](#) presents an overview of the e-learning framework of scanning, responding, and reflecting on how to facilitate the adoption of the reflective reading-based e-learning approach. The e-learning platform consists of an e-learning material system, BookRoll (Flanagan & Ogata, 2018) and a learning analysis system, Analysis Tool (Akçapinar et al., 2020), as well as a learning management system, Moodle (Büchner, 2016) for the instructor to upload course materials and monitor learners' profiles and their reflective reading activities. Furthermore, three databases were established to work with the systems: a learner profile database to store learning information and account, a course content database to store text materials, and a learning portfolio database for storing learners' reflective reading records of learners.

The e-learning platform is built on the learning management system (Büchner, 2016). In this platform, learners transition from an e-learning platform connected to the learning management system through a proprietary peer-to-peer single sign-on mechanism called MNet (Büchner, 2016; Flanagan & Ogata, 2018). Learners can initially log into one part of the platform. The e-learning material system (Flanagan & Ogata, 2018) has been adjusted to accept delegated access logins. Learners can click on the links to go to the e-learning material system and the learning analysis system in the learning management system using the same browser. The learning analysis system (Akçapinar et al., 2020) is directly integrated into the learning management system as plug-ins that reside on the course sites. These plug-ins require immediate access to the database of the e-learning material system to preprocess the data regularly and therefore need to be tightly integrated. Since these plug-ins reside in the learning management system, teachers have access to the data of the whole class on their reading time, their number of markers, quiz scores, and memo lists. Therefore, the instructor can directly monitor and evaluate the number of reflective memos and the word count of the learners from the e-learning system. Furthermore, in class, the instructor would present and discuss the successful examples in the learning analysis system to the class, so that other learners could view and learn the reflective memos that the instructor thought were good and improve their reflective skills.

**Figure 1**

*An Overview Framework for the Reflective Reading-Based E-Learning System*



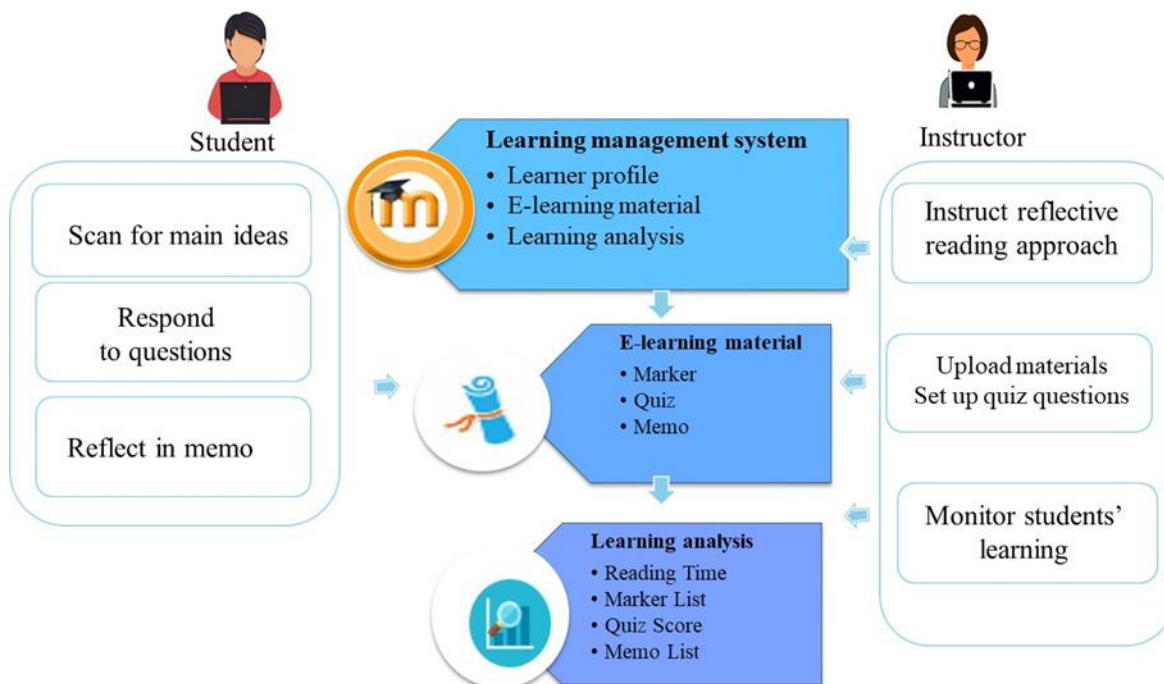
The instructor taught the participants how to use the reflective reading-based e-learning approach on the e-learning platform. Then, the instructor uploaded course materials and set up the quiz questions in the e-learning material system. The e-learning material system, the lecture slides, and the course materials—including the prompt questions designed for reflection—were uploaded in PDF format to the system. The learning analysis system helped the instructor monitor the learning process. This study used scanning, responding to questions, and reflecting as reflective reading activities. These three activities provided a record structure to keep track of the participants' learning routines during the experiment. The monitoring was carried out particularly during the in-class reading activities when the instructor was concerned with the general progress of the learners' development in reading. One of the objectives of the activities was to point out errors in the learners' responses to the questions and to encourage self-correction. The monitoring helped the instructor to be aware of how the class performed, whether the pace was too fast or too slow, and which learners may need individual attention as they did not put on the right mark for main ideas during task achievement. These activities also kept learners engaged in reading while using the e-learning material reading system, as shown in [Figure 2](#). Scanning supports learners in developing their reading comprehension (Salmerón et al., 2017) and facilitates the reconstruction of text structure by asking readers to focus on the main ideas (Fauzi & Raya, 2018; Hong, 2013). Answering text-based questions help promote deep understanding and enable learners to process their thoughts to solve problems (Christidamayani & Kristanto, 2020; Kalmpourtzis, 2019). The learners were required to express their ideas and understandings

and reflect on them through writing or other tasks. Developing habits of mind related to problem-solving has traditionally been one of the purposes of memo writing (Nourdad & Asghari, 2017). Reflective memos enable the learner to filter, reframe, organize, collect, process, and feel their experiences and help to promote reflection and contribute to the understanding of new knowledge (Hassan et al., 2019; Lee, 2010).

Studies by Aziz (2019) and Chen et al. (2020) found that the use of appropriate reading strategies was effective in improving learners' reading comprehension. The experimental group was instructed in advance to use the marker function to indicate the main idea, use the quiz function to respond to the reading questions, and type their reading reflection in the memo function in the e-learning system. That is, the learners scanned for the main ideas by highlighting with the marker, read the questions that the teacher had created, and responded to the questions with the quiz. The last step of the reflective reading-based approach was to make reflections in the memo about what they had read and learned. Learners were provided with reflective writing prompts tailored from Sage and Sele (2015). They were required to answer the following prompt questions to illustrate their reflective insight: (a) What did you learn in this reading? (b) What do you not fully understand? (c) Have you improved your English skills from this reading? (d) How have your ideas changed as a result of this reading? (e) How do you apply the concepts learned in this reading to your daily life?

**Figure 2**

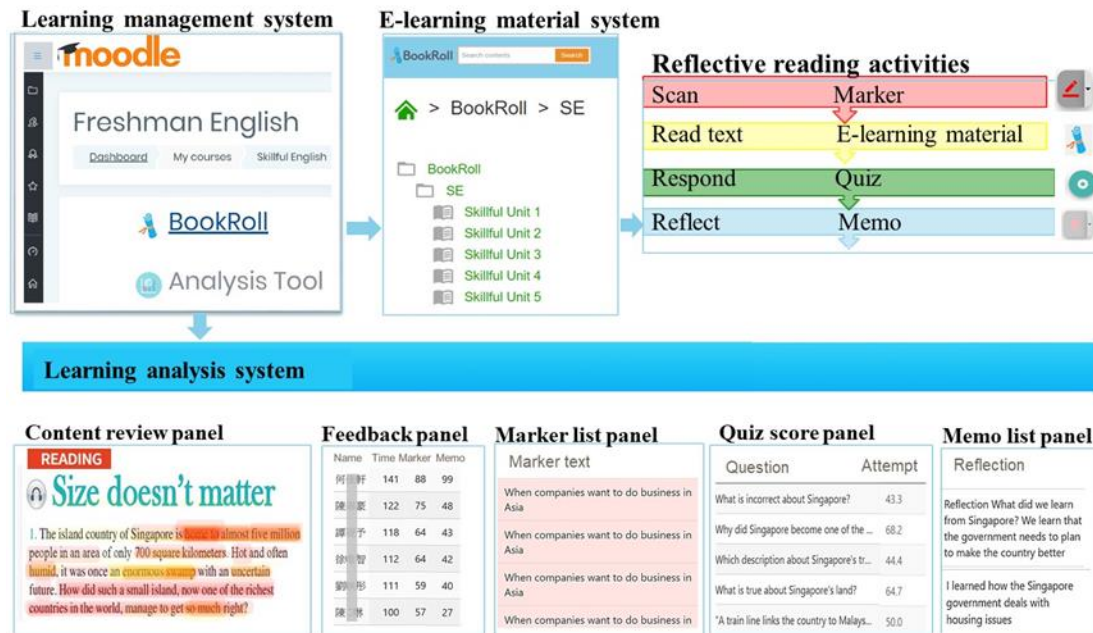
*Reflective Reading-Based E-Learning Procedure*



Once the learners marked the main ideas, responded to the questions in the quiz, and reflected in the memo in the e-learning system, their learning action events were recorded and displayed in the analysis tool on the dashboard as their learning log data, as shown in Figure 3. In other words, teachers monitored their learning on the dashboard and shared their learning performance in the class.

Figure 3

Interface of Reflective Reading-Based E-Learning System



## The Purpose of the Study

In the present study, the reading activities in the reflective reading-based process were designed on an e-learning system to support reflective thinking in reading and behavioral engagement. The reflective reading-based e-learning approach was proposed to help learners. This study aimed to investigate the impact of the proposed approach on the comprehension of the text, reflective thinking, and behavioral engagement of the participants.

## Methods

This study examined the effects of the reflective reading-based e-learning approach on learners' reading comprehension, reflective thinking, and behavioral engagement. This study used a quasi-experimental design to take full advantage of quantitative methods. The quasi-experimental design was used to identify the control group that is highly similar to the experiment group in terms of preintervention characteristics (White & Sabarwal, 2014). The control group would reflect the possible outcome if the reflective e-learning approach was not implemented. In addition, Bloomfield and Fisher (2019) stated that quantitative methods are intended to control the effects of confounding factors and improve external validity.

## Participants

Data were collected from two mandatory freshman English classes in northern Taiwan. The participants were two classes of 64 learners each, both of which were taught by the same instructor. The experimental activities designed as part of the course followed general college English education guidelines. A total of 101 participants completed questionnaires with consent forms to participate in the experiment. Fifty-one learners from one class and fifty learners from the second completed all pretests and post-tests. The ages ranged from 18 to 21 years old. Their English proficiency was classified as elementary level (Qu et al., 2017) based on their TOEIC (Test of English for International Communication) tests evaluated on their college entrance exams. The university TOEIC test placed participants in the English proficiency between elementary and elementary plus, with scores ranging from 250–450 and a mean score of 322.67 ( $SD \pm$



66.45). Participants were randomly assigned to the reflective reading-based e-learning group ( $n = 50$ , 27 males, 23 females) and the conventional e-learning group ( $n = 51$ , 29 males, 21 females).

### Experiment Procedure

To explore the impact of the reflective reading-based e-learning approach, an experiment was conducted in a freshman English course to assess reading comprehension, reflective thinking, and behavioral engagement. The freshman English course was designed to prepare learners for academic work with the necessary English reading skills to engage in themes, texts, and discourses. The language center of the university formally assigned a course textbook, *Skillful 1: Reading and Writing* (Bohlke, 2018), to learners of this grade level.

At the beginning of the semester, participants in both groups received instructions on how to use the e-learning system. Participants in both control and experimental groups studied the same units from the textbook. Since both had access to the system, they were both encouraged to use it in their learning. Table 1 shows the differences in the instructional procedures, with the experimental group using a reflective reading-based instructional approach in Steps 4 and 6. For Step 4, the group was specifically instructed to scan for main ideas, answer questions, and write reflective memos in class as the teacher conducted guided reading. Meanwhile, the control group was told to write their notes on the learning system and were encouraged to write vocabulary, sentences they did not understand, or any information they considered important in the system for review and future reference. Participants in the experimental group were instructed to use the e-learning system to learn the course materials appropriately with the reflective reading-based approach, while participants in the control group used the e-learning material reading system following the regular reading strategies instructions from the textbook. However, highlighting the main ideas in memos or engaging in reflection was not compulsory for the experimental group. The participants in both groups discussed the theme-based unit questions in the classes together with the instructor.

**Table 1**

#### *Teaching Procedures for Unit 4*

	<b>Experimental Group</b>	<b>Control Group</b>
Week 7	<ol style="list-style-type: none"> <li>1. Warm-up Activities</li> <li>2. Vocabulary learning</li> <li>3. Grammar introduction</li> <li>4. Guided reading with the reflective reading e-learning approach (scan for main ideas, respond to questions, write reflective memos, take notes in the e-learning system)</li> </ol>	<ol style="list-style-type: none"> <li>1. Warm-up Activities</li> <li>2. Vocabulary learning</li> <li>3. Grammar introduction</li> <li>4. Guided reading with a conventional approach (read the textbook, answer textbook questions, and take notes in the e-learning system)</li> </ol>
Week 8	<ol style="list-style-type: none"> <li>5. Practiced the reflective reading-based e-learning approach</li> <li>6. Shared and discussed learners' reflective memos</li> <li>7. Comprehension check</li> </ol>	<ol style="list-style-type: none"> <li>5. Guided reading with a conventional approach</li> <li>6. Completed unit 4 exercises in the textbook</li> <li>7. Comprehension check</li> </ol>

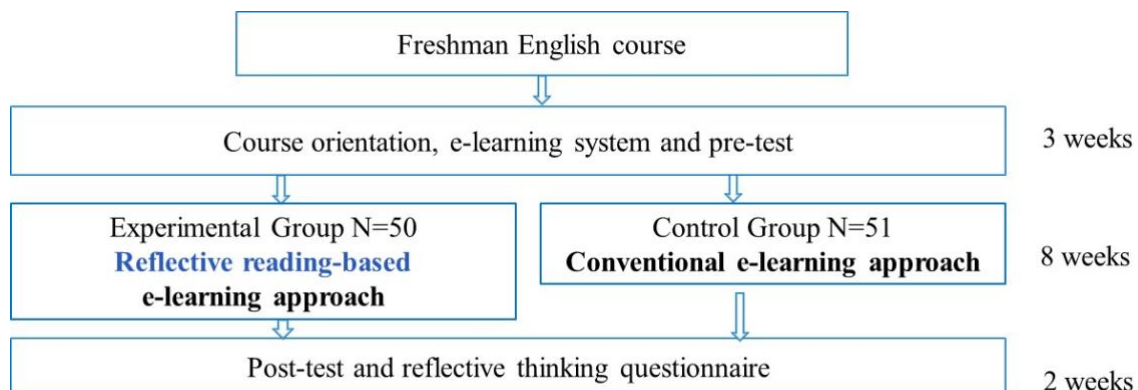
Figure 4 shows the procedure of this study. The experiment was conducted in a 13-week long freshman English course to improve freshman English reading and reflective skills. Before the experiment, learners in both groups practiced using the functions of the e-learning system individually in the class and took a pretest to assess their prior knowledge of English. Afterward, participants in the reflective reading-based e-learning group had to learn to apply marker drawings to the main ideas, read, answer questions, and reflect on the text in a memo. Learner responses to the text were first written and reflected in a reflective reading memo. Here, learners could further write down associations, questions, and reflections. Through reflective

reading memos, learners can make direct connections between texts and allow readers to make connections as they read.

However, the learners in the control group were instructed conventionally. They followed the reading exercises in their course textbooks as usual to complete the textbook questions on the e-learning system. They also used the e-learning system and e-learning materials to complete their post-reading exercises. These post-reading exercises in the coursebook included matching the main ideas in the text, completing sentences, and identifying true or false statements. After eight weeks of different learning methods, learners in both groups took post-tests and reflective thinking questionnaires.

**Figure 4**

*The Procedure of the Experiment*



### Reading Comprehension

The pretests and post-tests were administered using the test pool provided by the publisher of *Skillful Reading & Writing*, second edition (Bohlke, 2018). Two experienced college EFL teachers ensured the validity of the tests. The questions in the pretest and post-test were different. The pretest and post-test consisted of three components: vocabulary, grammar, and reading questions that focused on English reading comprehension skills. The pretest measured participants' prior English language proficiency, and the post-test was designed to monitor learners' reading comprehension of the units of study. The pretest and post-test were scored out of a total of 100. The Cronbach's alpha value was 0.74 for the pretest and 0.79 for the post-test.

### Reflective Thinking Questionnaire

Kember et al. (2000) developed the Reflective Thinking Questionnaire to measure learners' reflective thinking tendencies. The questionnaire was translated into the learners' L1 by two native Chinese researchers so that the learners could understand the items. To determine the validity of the translated questionnaire, a confirmatory factor analysis (CFA) was performed. The model consisted of four factors: comprehension, habitual action, reflection, and critical reflection (Ghanizadeh, 2017). Furthermore, the measured constructs were drawn from the extensive literature on reflective thinking (Kember et al., 2000). Each construct consisted of 16 items surveyed on a 5-point Likert scale ranging from *strongly disagree* (1) to *strongly agree* (5) and four constructs: comprehension (Cronbach's alpha = 0.98), habitual action (Cronbach's alpha = 0.86), reflection (Cronbach's alpha = 0.90) and critical reflection (Cronbach's alpha = 0.86).

### Behavioral Engagement

Participants' behavioral engagement was collected directly from the learning records generated in the e-

learning system. The learning records consisted of data such as the total time spent in minutes as reading time (Reading Time), several markers added as scanning (Marker list), question scores as response (Quiz score), and many memos as reflective reading (Memo list). The effects of reading comprehension, reflective learning questionnaires and behavioral engagement records in the system were calculated using the SPSS statistical analysis system SPSS.

## Results

### Analysis of English Reading Completion

To examine the effect of the reflective reading-based e-learning approach on English reading comprehension compared to the conventional e-learning approach, a one-way analysis of covariance (ANCOVA) was utilized with the pretest scores as a covariate, the learning approaches as an independent variable, and the post-test scores as a dependent variable. After testing that the assumption of the homogeneity of slopes was met with  $F = 0.39$  ( $p > 0.05$ ), it was reasonable to perform further analysis with ANCOVA. As indicated in Table 2, there was a statistically significant difference between the two groups with  $F = 6.26$  ( $p < 0.05$ ,  $\eta^2 = 0.059$ ). Furthermore, the adjusted mean of the experimental group was 79.89 ( $SD = 8.52$ ), which was significantly better than the adjusted mean of the control group with 74.81 ( $SD = 8.52$ ). This indicated that the reflective reading-based e-learning approach had significantly more positive effects on learners' reading comprehension than the conventional e-learning group.

**Table 2**

*ANOVA of Post-test Reading Comprehension for Two Groups*

Group	<i>N</i>	<i>M</i>	<i>SD</i>	Adjust M	<i>F</i>	$\eta^2$
Reflective reading-based	50	79.60	8.52	79.89	6.26*	0.059
Conventional	51	75.09	9.52	74.81		

Note. \*  $p < .05$ .

### Analysis of Reflective Thinking

The results of reflective thinking for the two e-learning approaches are shown in Table 3. The mean of reflective thinking perceptions for the experimental group was 4.09 ( $t = 3.96$ ,  $p < .001$ ,  $d = 0.79$ ), which was significantly higher than that of the conventional group (mean = 3.70). The learners in the reflective reading-based e-learning group achieved significantly higher reflective thinking than those in the conventional e-learning group. In other words, the e-learning approach can effectively enhance reflective thinking.

**Table 3**

*Independent Sample T-test Results of Reflective Thinking*

Group	<i>N</i>	Mean	<i>SD</i>	<i>t</i>	Cohen's <i>d</i>
Reflective reading-based	50	4.09	0.37	3.96***	0.79
Conventional	51	3.70	0.60		

Note. \*\*\*  $p < .001$ .

Furthermore, the results of reflective thinking for the two e-learning approaches of each dimension is shown in Table 4. Three out of four dimensions showed significant differences between the two groups—in particular, for understanding ( $t = 4.98$ ,  $p < .001$ ,  $d = 0.99$ ), reflection ( $t = 2.94$ ,  $p < .001$ ,  $d = 0.95$ ), and habitual action ( $t = 2.89$ ,  $p < .001$ ,  $d = 0.57$ ). Such findings could provide further evidence that the learners who learned with the reflective e-learning approach showed more positive understanding, reflection, and

habitual action than those who learned with the conventional e-learning approach.

**Table 4**

*Results of the Independent Sample T-test for Technology-Enhanced Active Learning Experience in Each Dimension of Reflective Thinking*

Dimensions	Group	<i>N</i>	Mean	<i>SD</i>	<i>t</i>	Cohen's <i>d</i>
Understanding	Reflective reading-based	50	4.61	0.53	4.98***	1.00
	Conventional	51	3.86	0.92		
Reflection	Reflective reading-based	50	4.20	0.54	2.94***	0.95
	Conventional	51	3.82	0.71		
Habitual Action	Reflective reading-based	50	4.06	0.63	2.89***	0.58
	Conventional	51	3.66	0.76		
Critical Reflection	Reflective reading-based	50	3.50	0.67	0.36	
	Conventional	51	3.45	0.75		

Note. \*\*\*  $p < .001$

### Analysis of Learning Behaviors

To assess the behavioral engagement of learners in the e-learning system, the total time spent in minutes as reading time (Reading Time), the number of markers added as scanning (Marker list), question scores as response (Quiz score), and number of memos as reflective reading (Memo list) on e-learning materials were analyzed. Table 5 shows the results of the t-test of the comparison of the reflective reading-based group (Mean = 213.88,  $t = 2.91$ ,  $p < .001$ ,  $d = 0.58$ ) that spent significantly more time than the conventional group (Mean = 138.90). Furthermore, the results also indicate that the reflective reading-based group (Mean = 151.68,  $t = 3.16$ ,  $p < .001$ ,  $d = 0.63$ ) scans (Marker list) more significantly than the conventional group (Mean = 91.02). Accordingly, the response of the learners in the reflective reading group (Mean = 77.56,  $t = 3.50$ ,  $p < .001$ ,  $d = 0.70$ ) was significantly higher compared to the conventional one (Mean = 67.75). Similarly, the reflective reading group (Mean = 66.92,  $t = 4.21$ ,  $p < .001$ ,  $d = 0.84$ ) significantly annotated more than the conventional group (Mean = 32.69).

**Table 5***Results of the Independent Sample T-test for Learners' Behavioral Engagements of the Learners*

Dimensions	Group	N	Mean	SD	t	Cohen's d
Reading time (Reading time)	Reflective reading-based	50	213.88	151.75	2.91***	0.58
	Conventional	51	138.90	103.34		
Scanning (Marker list)	Reflective reading-based	50	151.68	113.17	3.16***	0.63
	Conventional	51	91.02	76.38		
Response (Quiz score)	Reflective reading-based	50	77.56	11.64	3.50***	0.70
	Conventional	51	67.75	16.15		
Reflective reading (Memo list)	Reflective reading-based	50	66.92	43.50	4.21***	0.84
	Conventional	51	32.69	38.07		

Note. \*\*\*  $p < .001$ .

### The Relationship Between Reading Comprehension, Reflective Thinking, and Behavioral Engagement

The correlation coefficient ( $r$ ) between the variables of the reflective reading-based approach was adopted to assess the relationship between reading comprehension, reflective thinking, and behavioral engagement. The post-test scores were used as reading comprehension, and a reflective thinking survey was used, which included reflective thinking, time spent (in minutes), and behavioral engagement. Table 6 presents the values related to the correlation coefficient ( $r$ ) between the variables studied. A highly significant correlation was observed between reading comprehension, reflective thinking, and e-learning engagement. The reading comprehension presented a significant correlation with the reflective thinking ( $r = .547$ ,  $p < .001$ ). In addition, the reflective thinking presented a significant correlation with reflective reading ( $r = .321$ ,  $p < .05$ ). Additionally, the learner group that adopted the reflective reading-based approach was found to be more engaged in e-learning and was most likely to yield a higher level of reflective thinking ( $r = .538$ ,  $p < .001$ ).

**Table 6***Correlations of the Reflective Reading-Based Group*

	Reading comprehension	Reflective thinking	Behavioral engagement
Reading comprehension	1		
Reflective thinking	0.547***	1	
Behavioural engagement	0.553***	0.538***	1
Reflective reading	0.021	0.321*	0.133

Note. \*  $p < .05$ , \*\*\*  $p < .001$ .

## Discussion and Conclusions

This study explored the reflective reading-based e-learning approach to promote EFL reading comprehension, reflective thinking, and behavioral engagement. The learners were asked to search for the main ideas, ask questions about what they read, answer questions, and reflect on their reading of the text. Analysis of the RQ1 results showed that the learners in the reflective reading-based e-learning group had significantly better reading comprehension than the learners in the conventional e-learning group. This implies that the positive effects of an online learning approach based on reflective reading are beneficial to learners' English learning. The findings of this study in this regard are consistent with studies conducted by Farahian et al. (2021), where both showed that when students' reflective thinking is developed, their comprehension can be improved.

Regarding RQ2, the results of the reflective thinking analysis showed that in the experimental group, the learners' perceived abilities in comprehension, habitual action, and reflection were significantly higher than in the control group. In previous research, it has been suggested that learners have more opportunities to develop reflective thinking when offered an organized and structured learning environment (Chen et al., 2020). As recommended by Moghaddam et al. (2020), learners develop a sense of learning through continuous, in-depth reflection on what they have learned and by actively engaging in the reflective process.

For RQ3, the analysis of the learning log revealed that learners' behavioral engagement, such as total time, markers, quiz scores, and reflective memos—which are the indicators of learning—was significantly better than that of conventional learning without the reflective reading-based approach. In other words, it can be concluded that when learners are taught an e-learning approach that applies reflective thinking, it can increase their use of the e-learning system and thus their behavioral engagement. It should be noted that behavioral engagement positively impacts learning outcomes in technology-mediated learning (Lee et al., 2021). Learners gain more from learning activities when they are more involved in the language learning process. Regarding the direct effect of behavioral engagement on comprehension, some researchers have found that the amount of time learners dedicate to reading tasks predicts their comprehension (Du & List, 2020; List et al., 2019). For example, Bråten et al. (2021) employed hierarchical multiple regression analysis to show that the behavioral engagement of time and length of responses significantly affected comprehension. Moreover, List et al. (2019) also used hierarchical multiple regression analysis to indicate that time spent on behavioral engagement and learners' time invested in text use predicted their post-reading products. The results of this study are similar to previous experimental studies that demonstrated the correlation between reflective skills and active engagement behaviors (Ghanizadeh, 2017). Thus, with these learning records on Learning Analysis (time spent reading, number of markers, reading response scores, and number of memos), instructors can effectively monitor learners' learning and address learners' difficulties, improving learning success.

Issue-based textbooks are those in which each unit of the textbook covers the topic of a particular issue as the main theme. The proposed approach was an aid to deeper learning. As the learning records on the e-learning system were examined, evidence of personal reactions was found. For example, in one unit entitled “great leaders and their character,” under the prompt question, “what did you learn in this reading?” under which many learners expressed their ideas about what a good leader should be. Participant A wrote “A good leader should take more responsibility than the people in his country.” Participant B wrote “I believe our leader should always take more than his share of the blame, think about how people want to be treated, and always take less credit.” This study echoed Teng (2020) that post-reading reflection enabled learners to use writing to express ideas and interact with their reading. As the topic-based textbook imparts knowledge that describes a great leader, the e-learning system helps learners put this knowledge to work and relate these experiences to their daily lives.

There was a significant correlation between reading comprehension, reflective thinking, and behavioral engagement, suggesting that learners who wrote more memos were more engaged in reflective thinking and that those who were more engaged in a reflective-based reading process made greater progress in their

English language learning. However, the Pearson correlation coefficient test also did not show a correlation between the experimental group's reflective reading and reading comprehension. Furthermore, there was no correlation between reflective reading and behavioral engagement. This result could be interpreted as a direct association between reflective reading and reflective thinking, but it is possible to be indirectly related to reading comprehension and behavioral engagement.

### **Limitations**

In this study, reflective memos were written in the form of questions and answers. The instructors prompted the participants to write reflective sentences or keywords in their memos, which is effective in learning English (Chen et al., 2021; Karami et al., 2021). The number of times the participants recorded reflections in the memo was used to measure reflective reading. This may be one of the study's limitations and the reason why reflective reading was not positively correlated with reading comprehension and behavioral engagement. For future research, qualitative evaluation of learners' reflective reading content can be considered (Karami et al., 2021). The results for the critical thinking dimension of reflection were not significant, as shown by the statistical results for critical reflection. The quality of memo writing cannot be improved when learners are asked to have critical thinking reflections without being further instructed (Farahian et al., 2021). In the future, teachers could help learners critically process the content of their reflections by providing scoring criteria for evaluation. In e-learning systems, explicit behaviors such as the time spent reading, the number of lines drawn, and the number of memos written were measured. However, to effectively assess participants' learning, interventions should be made in different dimensions of learner engagement and counting the frequency of memos to ensure the results of the reflective reading-based e-learning approach.

### **Suggestions**

It is recommended that teachers consider incorporating the reflective reading approach to e-learning and encourage learners to use a reflective reading-based e-learning approach when developing the four skills in foreign language learning. From the results of the study, it can be said that behavioral engagement is one of the key indicators of reflective thinking. Although behavior engagement is a multidimensional concept, this study successfully quantified behavior engagement as one of the dimensions of reflective reading-based learning. Suggestions for future research include a better assessment of higher-order thinking skills in reading, as reflective reading based on e-learning platforms is still new. These findings have important implications for developing insights into comprehension and engagement and the association with reflective reading. From these perspectives, this study provides information on the participation of EFL learners in reading. It provides educators, researchers, and system developers with information and inspiration on how e-learning can monitor learners' reading experiences to aid EFL learners' reading performance. The study offers practical ideas for teachers to utilize the data recorded in learning analytics. As a teacher specifies what learning behaviors they are looking for (scanning marks, responding to questions, reflective notes), with the dashboard providing visualizations for the class to discuss the behaviors recorded, these types of data can be designed into the class activity that targets specific individuals or the whole class to improve the learning in a classroom.

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## Statements on Open Data, Ethics, and Conflict of Interest

The data can be obtained by sending request e-mails to the corresponding author. The participants were protected by a confidentiality agreement during the research process. They knew that participation was voluntary, and they could withdraw from the study at any time. There is no potential conflict of interest in this study.

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