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Chapter 10

The Cyclic Model of Learning: An Attempt Based on the DBR in an EFL context

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Abstract

The purposes of this paper are to (a) elaborate on the Cyclic Model of Learning (CML; Takeuchi, 2007), which was formed based on the four phases of the design-based research (DBR) framework (Amiel & Reeves, 2008); (b) to put the model into practice through use of technology in the field of EFL teaching; and (c) to examine how the CML-based teaching practice influences students' English ability and the instructor's teaching methods. Based on the four phases of the DBR framework, a qualitative investigation was conducted to identify the problems that impede teachers' use of technology in EFL teaching (Sumi, 2011). To ameliorate the problems, following the second phase of the DBR framework, the CML was created and applied to a research project. The most distinctive feature of the CML is its integration of in-class practices with students' out-of-class self-learning with aid of CALL technology. The CML was put into practice and tested on 19 first-year undergraduate students of EFL over the course of one year at a university in Japan. Data were collected, both on- and off-line, in a variety of ways including quizzes, weblog, video recording, questionnaires, and classroom observation. Findings confirmed that CML-based teaching practice contributed to the improvement of both students' English abilities and the instructor's teaching methods.

Keywords

The Cyclic Model of Learning, Design-based Research, Ecological Perspective, EFL, Integration

1. Introduction

Studies of CALL have been experiencing a transitional shift consisting of three stages. According to Warschauer and Healey (1998), CALL research has developed from drill-based "structural CALL" via communication-based "communi-

cative CALL” to content-based “integrative CALL,” which has a sociocultural perspective as its background. In addition, Warschauer and Healey noted the importance of incorporating technology use into teaching practices. Bax (2003), in this connection, pointed out the significance of developing an integrated practice that puts students at the center and enables tutors and students to use technologies for foreign language teaching and learning in a natural educational environment.

Influenced by the aforementioned trend of integrative CALL, many researchers have proposed design-based research (DBR). To the best of the authors’ knowledge, Yutdhana’s (2005) overview is one of the first publication of DBR in CALL, and since then, its potential for CALL has drawn considerable attention. The most distinctive feature of DBR is that it bridges the gap between theoretical research and educational practice (The Design-Based Research Collective, 2003) and is expected to advance theories of learning through actual teaching practices (Sandoval, 2004). Additionally, the current direction of CALL research and the concept of DBR share many common features. Despite this, however, only a handful of studies have been conducted based on DBR in the field of CALL (Hung, 2011).

2. DBR in CALL

The origin of DBR is most closely associated with Brown (1992) and Collins (1992). At this stage of development, DBR was labeled as design experiment (DE) in consideration of research focus, practice, and underlying epistemology (Bell, 2004). DE focuses on understanding of a “learning ecology” (Cobb, Confrey, diSessa, Lehrer, & Schauble, 2003), which consists of complex elements of an interacting system of teaching and learning with different types and levels. In contrast to other research methodologies that reduce complex teaching and learning practices to a simple cause-and-effect model with a list of separate factors, DE aims to give a holistic explanation to a design-based practice and has greatly influenced educational studies.

Since DE first appeared in the field of educational studies, it has grown in diversity. As a result, it has become difficult to find theoretical or methodological coherence among efforts purporting to be design experiments (Bell, 2004). In light of the widespread nature of DE, the Design-Based Research Collective (2003) proposed DBR by newly configuring theoretical and methodological advantages of the design-based approach. Their work clearly underlined the character of DBR and showed the direction of ensuring educational studies based on DBR.

With its flexible and practical characters and implications (Cobb et al., 2003), which are beneficial to educational settings that face the new challenges brought on by technological innovation, DBR has begun to be practically applied to teaching practices. Although the number of such teaching practices is quite limited (Hung, 2011), their variety is growing. For example, in the field of mathematics education, Gravermeijek and Cobb (2006) applied a DBR framework to teaching practice and contributed to identifying a local instruction theory. Additionally, in order to respond to the demand of undertaking scholarly inquiry into university teaching and learning practices, Sharma and McShane (2008) administrated

workshop tutorials based on DBR. Yutdhana (2005) introduced DBR as an effective alternative to CALL research and described its two key features as follows:¹

1. designing learning environments, and
2. developing theories of learning

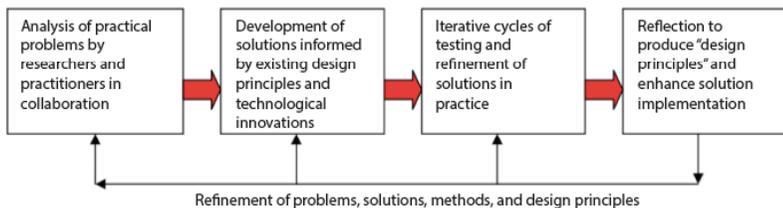
In the next section, we describe a teaching method that was designed based on the DBR framework and implemented in an EFL context.

3. The Cyclic Model of Learning

The four phases of the study are shown below according to the DBR framework (see Figure 1) illustrated by Amiel and Reeves (2008). Following the four phases described in the DBR framework, we conducted a qualitative research study, designed a solution, tested it, and documented the results along with our reflection on their theoretical and practical implications.

Figure 1

The Design-Based Research Framework (adapted from Amiel & Reeves, 2008, p. 34)



3.1 Phase 1: Analysis of Practical Problems by Researchers and Practitioners in Collaboration

In Phase 1, interviews were conducted to evaluate instructors' use of technology in the Japanese EFL context and to identify practical problems that impede instructors' use of technology in foreign language teaching (Sumi, 2011).

The interviews were carried out with 24 participants (12 males and 12 females), all of whom were English instructors experienced in using Language Laboratory (LL) or CALL facilities in the Japanese EFL context. Except for one who was teaching at a junior high school, all were teaching at tertiary institutions. They were selected because of their broad teaching experience and their experience using LL or CALL facilities and computers. Their average length of teaching career was 14.79 years ($Max = 30$, $Min = 1$, $SD = 8.64$ [year]) and experience of using computers was 17.79 years ($Max = 30$, $Min = 5$, $SD = 7.11$ [year]). Nineteen of them had experience using LL facilities, and 16 had experience using CALL facilities.

¹ For more details about the history of DBR and the connection between DBR and CALL research, see Pardo-Ballester and Rodríguez (2009).

A part of the Grounded Theory Approach procedure (Corbin & Strauss, 2008, Chapters 8 and 9) was used in the analysis of the data collected through the interviews.² According to Corbin and Strauss, the Grounded Theory Approach is “a specific methodology developed by Glaser and Strauss (1967) for the purpose of building theory from data” (p. 1), and the analysis in the approach is “a process of examining and interpreting data in order to elicit meaning, gain understanding, and develop empirical knowledge” (p. 1).

MaxQDA 2007 (Kuckartz, 2007) was utilized as a tool for analyzing the data. This software was developed especially for qualitative analysis (Corbin & Strauss, 2008; Lewins & Silver, 2007).

The results revealed three factors that seemed to impede the use of technology in the Japanese EFL context:

1. technology (4 subfactors)
2. environment
3. institution (2 subfactors)

3.1.1 Technology factor

The technology factor includes (a) gaps in intention between system developers and instructors, (b) system instability, (c) operation complexity, and (d) constrained technology settings. The first problem cited by most instructors was the gap between what system developers thought instructors wanted to do and what the instructors actually wanted to do. In addition, the instructors complained about the instability of CALL systems. This problem tends to occur when students log in all at the same time or the instructor sends out large amounts of data. As a result, CALL operating systems become unbearably unstable when processing data traffic, and they sometimes freeze. A number of instructors also reported that operation complexity is another problem. The problem of operation complexity especially occurs when an instructor alternately uses several devices in succession. The last factor, the constrained technology settings of CALL classrooms, prevents instructors from using technology. For example, internet access is limited at one institution for security reasons.

3.1.2 Environment factor

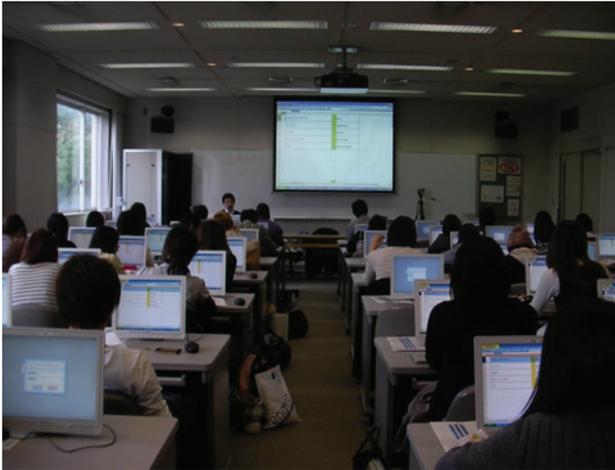
The environment factor contains no subcategories. Most of the instructors' comments centered on the CALL/LL classroom size. In the Japanese context, CALL classrooms are usually designed to accommodate a large number of students. The classroom size, therefore, is often bigger than usual. In addition, the classrooms are crammed with a maximum number of desks, chairs, and computers. The room size and equipment obstacles can impede smooth interaction between the instructor and students. Figure 2 shows an example of a CALL classroom. The classroom

²According to Corbin and Strauss (2008), there are four steps in the process of the Grounded Theory Approach: open coding, axial coding, comparative analysis, and conceptual saturation. In this study, the steps from open coding to comparative analysis were applied.

was designed to accommodate about 60 students, and each student had an individual computer, leaving almost no space available for instructor-student interaction.

Figure 2

A CALL Classroom



3.1.3 Institution factor

Lastly, the institution factor, which includes the lack of (a) teacher support and (b) teacher training, should be explained. These factors were also identified in Chambers and Bax (2006). Most of the instructors interviewed reported they would like to have some sort of support or teacher training in the use of technology in foreign language teaching.

3.1.4 Summary of interviews

Through the interviews, three impeditive factors emerged: (a) technology, (b) environment, and (c) institution. Instructors use facilities in a limited way, adjusting their teaching styles or lesson plans to the environmental and technological settings of the classroom. Many instructors believe that using computers for foreign language education is effective, but LL or CALL facilities are not necessarily utilized as intended and are often regarded as impeding face-to-face interaction between the instructor and students. Instructors also tend to be fearful of using technologies for teaching because of the complexity of the system features and interface design of CALL facilities.

The authors suspect that the instrumental perspective (Warschauer, 1998), which views technology in isolation from its users and their contexts (G. E. Kersten, Kersten, & Rakowski, 2004), can be a root cause of these problems. If we base our teaching approach on that perspective, we can easily presume the usefulness of new technology and adopt it without considering the classroom contexts wherein teachers actually use technology in language teaching. Similarly, Bax

(2003) criticized the instrumental perspective as the “Sole Agent fallacy” (p. 26), which means that neglecting the factors indispensable for successful CALL implementation discourages its use in teaching. The following instructor’s comment seems to summarize succinctly a dilemma that may be shared by many instructors in the Japanese EFL context:

If I could use technology appropriately during lessons, it could help my students understand better and I could make my lessons more appealing. But, in reality, I am just worried about using it in a way that goes beyond my current skills. I do not want to waste my time just on handling devices during lessons, so I use them as far as I can handle them.

3.2 Phase 2: Development of Solutions Informed by Existing Design Principles and Technological Innovations

3.2.1 Ecological perspective

In Phase 2, an instructional model and learning environment were designed as a solution with design principles and technological innovations. In the previous phase, three factors were identified (i.e., technology, environment, and institution), and we concluded that the instrumental perspective can cause problems that impede instructors’ use of technology in foreign language teaching. We believe, however, these situations can be improved by taking an alternative perspective, namely, the ecological view, into account in designing and implementing technology for foreign language teaching (Bax, 2000, 2003; Chambers & Bax, 2006; Tudor, 2002, 2003).

According to Tudor (2003, p. 4), “an ecological perspective involves exploring language teaching and learning within the totality of the lives of the various participants involved, and not as one sub-part of their lives which can be examined in isolation.” Therefore, an ecological perspective on the use of technology for foreign language teaching involves exploring language teaching within the totality of the context in which it actually occurs (Warschauer, 1998).

From the ecological perspective of second language acquisition, van Lier (2004) proposed ecological linguistics and argued that language learning emerges from the context in which language learners are engaged and wherein they draw on affordance. According to him, affordance for language learning means “a relationship between an organism (a learner, in our case) and the environment that signals an opportunity for or inhibition of action” (p. 4). In this sense, the person and the environment are inseparable in a context (Thorne, 2003; Zukow & Ferko, 1994). Applying this idea to CALL research, it can be said that persons (i.e., teachers and learners) and technology are interrelated in the classroom context.

Bronfenbrenner (1989, p. 188) defined human development as “a joint function of person and environment” and formulated the theory based on Lewin (1935) as follows:

$$D = f(PE)$$

According to Bronfenbrenner (1989), *D* refers to “development,” *P* to “person,” and *E* to “environment.” *D* is a function of both personal and environmental factors. In a similar vein, we believe that technology use in foreign language teaching cannot be discussed separately from the context and should be integrated into the teaching context. To put into effect an ecological perspective with the foregoing in mind, we present an extended version of Bronfenbrenner’s formula as a design principle for developing a teaching model:

$$U = f(PCT)$$

In this formula, *U* refers to the “use of technology in foreign language learning,” *P* to “person,” including teachers and learners, *C* to “classroom context,” and *T* to “tools.” The process of technology use in foreign language teaching can be described as a joint function of person, classroom context, and tools. By looking at technology use in our field by means of this formula, we think that technology can obtain a “field of meanings” (Wenger, 1990) and be integrated into the classroom context (cf. “normalization,” Bax, 2003).

3.2.2 The Cyclic Model of Learning (CML)

Based on the ecological perspective, CML (Takeuchi, 2007) was designed with a special focus on the local context, namely, Japanese EFL classrooms. The most distinctive feature of the CML is that it integrates in-class teaching practices with students’ out-of-class self-learning with the aid of technology. In addition, the CML attempts to elicit student participation in lessons and to promote self-learning outside the classroom, both of which are considered to be indispensable to successful EFL learning (Takeuchi, 2002).

In CML, the process of foreign language teaching cannot be divided into a series of single in-class lessons but rather is considered to be a cumulative result of each in-class lesson and students’ out-of-class self-learning. As van Lier (1998, p. xv) argues in reference to Breen (1985), “a genuine second-language learning environment in which language development primarily occurs outside the classroom, but can be intensified and consolidated inside it.” Further, van Lier (1996, p. 43) insists, “The more lessons I observe, the more I become convinced that language development occurs *between* lessons rather than *during* lessons” (original italics). These remarks seem to support the main idea stipulated in CML that two distinctive but interrelated flows are essential in the teaching process. These two flows are (a) a teaching flow within the lesson, which refers to how an instructor conducts one lesson, and (b) a teaching flow between lessons, which connects one in-class lesson with the next via technology. These two teaching flows create the classroom context in which actual language teaching and learning occur. Figure 3 presents an overview of the classroom context in CML.

In CML, furthermore, preparation and reflection phases are implemented before and after each lesson (a) to facilitate the teaching flow within the lesson, (b) to reinforce the teaching flow between lessons, and (c) to connect these two flows (see Figure 4). In the preparation phase, technology is used to provide resources related to the lesson in order to activate students’ schema and prepare them for

the lesson. Then, in the lesson, the instructor facilitates students' use of the target language and elicits their participation in classroom activities. Afterward, in the reflection phase, students are guided to review the lesson through the resources provided via technology.

Figure 3
Overall Picture of the Classroom Context

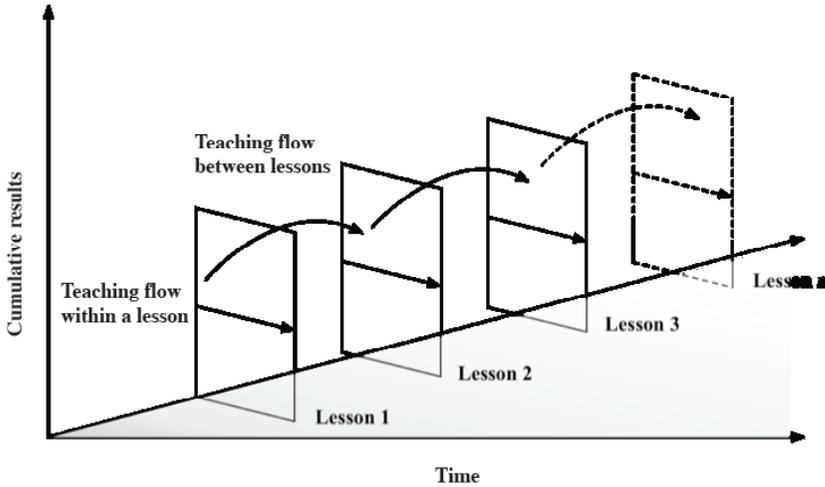
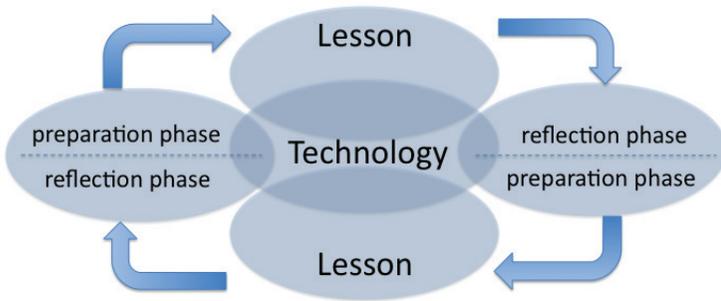


Figure 4
Cyclic Model of Learning



CML also makes it possible to expand time and space for teaching (Sumi, Takeuchi, Yamamoto, & Nabei, 2005). This extension can often reinforce students' commitment to the class and thus facilitate their voluntary learning out of the class. To learn English in the Japanese EFL context, self-learning beyond school lessons is essential. According to Saegusa (1985, 1993), in order to reach Level 3 on the Foreign Service Institute Scale, students must spend 1,920 to 2,280 hours

learning English. This means that if a student starts learning English in the first year of lower secondary school (seventh grade) and finishes at the end of university, the number of learning hours needed to reach Level 3 would be 2.5 times that required in schools in the Japanese EFL context. However, by effectively utilizing time between lessons and using the resources provided by means of technology outside the class, students can significantly expand their learning hours. Thus, we believe the CML can be an effective solution for ameliorating the major disadvantage of learning English in the Japanese EFL context, that is, a dearth of learning hours.

3.2.3 Technological innovation

To integrate in-class teaching practices with students' out-of-class self-learning and to implement the preparation and reflection phases before and after each lesson, we decided to use web technology such as a learning-management system (LMS) because it has become extremely difficult and unnatural for instructors to limit the use of technology to the inside of the classroom. Warschauer (2005) said that students now use new technology *outside* rather than *inside* the classroom. Similarly, Taylor and Gisaki (2003) mentioned that the traditional CALL lab is no longer the only place where students are exposed to authentic resources for language learning through the use of technology.

From a technological viewpoint, the advancement of research on CALL has allowed web-based technologies such as LMS or CMS to be considered as an integration tool. The advantage of using such web-based technologies is that they allow tutors to supplement in-class instruction and to incorporate student self-learning into classroom activities (Kung & Chuo, 2002). For example, van Deusen-Scholl, Frei, and Dixon (2005) identified the advantage of using online resources, stating

One in-class activity determines its continuation online, and the online activity determines the following in-class activity. This cycling—or spiraling—builds the foundation for on-going reflection of language production and complexity. (p. 664)

Similarly, Levy and Kennedy (2004) employed web-based audio-conferencing tools as a means of allowing students to speak in the target language outside scheduled class time. More recently, Stickler and Hampel (2010) provided a Moodle-based intensive online German course, and Sumi and Takeuchi (2010) conducted blended learning practices using an LMS in junior high school and university environments. These features and advantages of using web-based technologies soundly fulfill CML's precepts and ameliorate problems found in the first phase.

3.3 Phase 3: Iterative Cycles of Testing and Refinement of Solutions in Practice

3.3.1 Implementation of CML

In Phase 3, to test the solution proposed in Phase 2, a teaching practice based on CML was designed, and it was tested on 19 (4 male and 15 female) first-year un-

dergraduate students over the course of one year. The class was an elective course open to students interested in advanced English lessons. Their English ability was relatively high for college students (TOEIC Test score range of 500 to 600),³ and they were highly motivated.

The course instructor had over 20 years of teaching experience and held a Ph.D. and two M.A. degrees in language teaching and its related fields. His first language was Japanese, and he had high proficiency in English, evidenced by almost full scores on the TOEIC and TOEFL tests.

The purpose of the class was to improve EFL students' reading ability. The class met for 90 minutes once a week for 13 weeks in each semester, which means that there were 26 lessons over the course of the academic year. Class was held in an ordinary small classroom with no computers. The lessons were mainly conducted in English. The classroom had portable chairs with flat writing tables, so that students could easily move them to form seating for pairs or groups (see Figure 5).

Figure 5

A Lesson in the CML-Based Class



In addition to in-class teaching practice based on the CML design principles, three roles were given to the LMS used in the study. The “pre-lesson” was the first phase of instruction. Its aim was to activate students’ schema and prepare them for learning. For this purpose, preview materials were posted on the LMS and made available to the students before the lesson. Figure 6 shows an example of the main page for the preview materials.

³ The maximum possible score on the TOEIC Test is 990. The average score of Japanese university students in 2010 was 445 (for more details, see <http://www.toeic.or.jp/toeic/pdf/data/DAA2010.pdf>).

Figure 6
Sample Main Page in the LMS

Unit 15 Andy Warhol's Early Years

COLUMN • Read 01 • Read 02 • Unit 15 復習 • 形音詞一覧

COLUMN

Read 01
Read 02
Unit 15 復習
形音詞一覧

Getting Ready to Read COLUMN

Back ground of the story

本文の背景: アンディ・ウォーホル(1928-1987)は本名をアンドルー・ウォーホル(Andrew Warhola)といい、1928年ペンシルバニア州で生まれたといわれています。アンディ・ウォーホルは1960年代を代表するポップ・アーティストと呼ばれています。彼の作品には、スーパースターや青森県秋田市のピンコといった日本の生活感あふれるものから、エルビス・プレスリーやマリリン・モンローの著名人をモチーフとした抜粋のひらめきの世界までが描かれています。(引用: 竹内、池田、西川(編著)、『Tapestry Reading』松田社)

彼の作品のオザリナリティーはどこにあるのでしょうか? また彼の作品に表現された当時のアメリカとはどのような国だったのでしょうか? 教科書を参考にしながら関連リンクなどをたどって彼の世界観に思いがけず理解を深めていきましょう。

STRATEGY

■Unit 15の読解方略

このUnitでは以下の読解方略について学びました。

■【読解方略その二】

■第一法則 N1 + N2 + V1 を見つけたら、N1 とN2の間に関係代名詞を挿入しよう

■第二法則 N1 + N2 + V1 のVは関係詞のV、必ず主語のV2を探しに行こう。」

このUnitでは、N + N + Vを見つけたら、Nの間に関係代名詞を挿入する読解方略について学びました。

例えば、The company I am affiliated with shows a great profit.を読み解くには?

MEMO

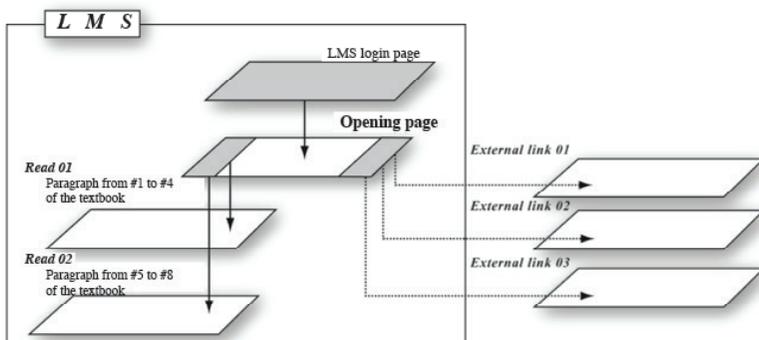
In the future, everyone will be famous for fifteen minutes. -ANDY WARHOL.

関連リンク

Warhol's Art Photo Site
Warholore
Warhol.com
Desk Tacy

The main page showed background information and reading strategies to help students understand the contents of the textbook. In addition, this page was divided into two columns. The left column contained links to a digitalized version of the textbook. There were two links labeled “Read 01” and “Read 02” respectively. The division of “Read 01” and “Read 02” was decided in accordance with the quantity of texts. By clicking the icons on the main page, students could see the text and listen to its narration in English. Then, the right column of the main page contained images and several external links to English language websites related to the textbook contents. These were provided with the goal of helping the students expand their knowledge beyond the contents of the textbook and gain exposure to authentic English. Figure 7 shows the layout of the learning materials on the LMS.

Figure 7
Layout of the Learning Materials in the LMS



The second phase of instruction was the lesson: The instructor taught a lesson in an ordinary small classroom (see Figure 5 above) rather than a CALL classroom. The main focus of this phase was to elicit student participation and utterances in the target language. Collaborative activities such as group work, pair work, and group competition were extensively used to facilitate both instructor-student and student-student interactions.

The last phase is the post-lesson focused on giving students both review and additional study materials through the LMS and also guiding them to the next lesson. All materials were developed and posted on the LMS through consultations with the course instructor. One of the authors also participated in every lesson and worked as a teaching assistant. Soon after the lesson, using the notes and recorded videotapes from class, he created materials that reflected the lesson contents and posted them on the LMS as resources for review and additional study. These materials included the important review points of the lesson and some additional information concerning the reading materials. At the beginning of each class, a quiz was given to assess students' understanding of the previous lesson. This encouraged the students to review the materials posted on the LMS because they often summarized main points that might appear as questions on the quiz.

3.4 Data Collection and Analysis

To examine the influence of the CML-based teaching practice on (a) the improvement of students' English ability and (b) the instructor's teaching methods, data were collected in a variety of ways based on the concept of triangulation. Triangulation is a research methodology that enables us to examine the complex structure of practices from multiple sources (Dörnyei, 2007).

To investigate the influence of the CML-based teaching practice on the improvement of students' English ability, a reading section of the First Certificate in English (FCE), which is a standardized ESL test developed by University of Cambridge ESOL Examinations, was administered. Scores on this test are considered to be a reliable indicator of general reading ability (Chalhoud-Deville & Turner, 2000).

The test was administered four times a year, at the beginning and end of each semester. The same test was used all four times, but the order of multiple-choice items in each section of the test was changed each time. In addition, the question and answer sheets were collected each time, and there was a relatively long interval between each test administration. Additionally, no advance notice was given that the same test would be used again. The test scores were analyzed using nonparametric statistical analysis because the number of students was small and the normality of the data could not be guaranteed (Siegel & Castellan Jr., 1988).

The relationship between students' number of access log entries and total quiz score was examined to determine whether there was a correlation between them. The quizzes were conducted at the beginning of each lesson to evaluate students' understanding of the previous lesson, and the quiz score was considered to be a

measurement of their achievement. Access log entries were automatically counted when the students logged into the LMS system to access the materials. The frequency of the access log entries was considered as indicator of how often the students used the materials for self-learning.

To investigate the influence of the CML-based teaching practice on the instructor's teaching methods, qualitative data from video recordings, field notes from the lessons, and interviews with the instructor were collected. Video data were categorized to explore how the instructor conducted the lesson. Twenty-six lessons were taught over the year, equivalent to a total of 39 hours of study. However, data from the lessons used for the class orientation, tests, and a guest speaker session were omitted. Therefore, 24 hours of data were included in the final categorization. An interrater reliability of 20% of the data analysis was calculated between the authors and a postgraduate student of foreign language education. The interrater agreement was 85.0%, which the authors judged to be an acceptable level (Potter, 1996). Disagreements between the raters were discussed and resolved. The questionnaire included 77 items that asked about (a) the lessons (26 items), (b) self-evaluation (7 items), (c) the instructor (6 items), (d) friends (7 items), (e) the teaching assistant (6 items), and (f) the LMS (25 items). The questionnaire items were designed through consultation with the course instructor. For each item, participants were asked to rate their agreement with the given statement on a 5-point Likert scale (5 *Absolutely agree*, 4 *Agree*, 3 *Somewhat agree*, 2 *Disagree*, and 1 *Absolutely disagree*). Cronbach's alpha was .82, which suggests strong consistency. All data related to the CML-based teaching practice were collected with the permission of the course instructor and the student participants.

3.4 Phase 4: Documentation and Reflection to Produce Design Principles

In Phase 4, the final phase, the data analyzed in Phase 3 were documented and interpreted to propose a new set of design principles and guidelines that can be referred to and followed by other similar practices within their specific educational context (Marden, Herrington, & Herrington, 2009).

3.4.1 Students' English ability

Table 1 shows the results of the reading section of the FCE test. The maximum possible score on the FCE test is 35. Data for only 17 students were analyzed, as two students were absent on one of the test days. The Friedman test was conducted to identify the overall differences among student scores on the four tests, and a significant difference was found ($\chi^2 = 15.93, p < .01, r = .38$), thereby confirming an improvement in the students' English proficiency level following the CML-based teaching practice (see Table 1).

Table 1
Results of the FCE Tests

FCE	<i>N</i>	<i>Mean</i>	<i>SD</i>	<i>Min.</i>	<i>Max.</i>	<i>Median</i>
First	17	17.41	3.86	10	24	17
Second	17	20.82	2.24	13	24	22
Third	17	22.35	3.92	13	27	23
Fourth	17	22.94	3.80	14	28	24

For an in-depth analysis, the students were divided into two groups based on their first FCE score. The cut-off point was 17 ($M = 17.41$, $SD = 3.86$), and the Mann-Whitney U test was applied to evaluate whether there was a significant difference in proficiency between the two groups. A significant difference was found ($U = 0$, $p < .01$, $r = -.85$). Accordingly, the two groups were designated as Group H (high score group [$n = 8$]) and Group L (low score group [$n = 9$]) (see Table 2).

Table 2
Student Grouping Based on the First FCE Score ($N = 17$)

Group	Student ID	First FCE Score	Rank
High	M02	24	1
High	F16	23	2
High	F03	21	3
High	M04	21	3
High	F04	20	5
High	F05	20	5
High	F07	20	5
High	F10	18	8
Low	F11	17	9
Low	F02	16	10
Low	F12	15	11
Low	F14	15	11
Low	F15	15	11
Low	F01	14	14
Low	M03	14	14
Low	M01	13	16
Low	F09	10	17

The Wilcoxon signed-rank test was used to analyze the difference of results between the first and fourth FCE for each group. A significant difference was found in Group L ($T = 1, p < .01, r = -.61$) but not in Group H ($T = 3, p > .05, r = -.47$) (see Tables 3 & 4).

In addition, the Mann-Whitney U test was applied to evaluate whether there was a significant difference between the two groups in terms of the fourth FCE results. No significant difference was found ($U = 22, p > .05, r = -.33$). This finding suggests that the Group L students notably improved their English ability and increased their test scores. As a consequence, the average scores of the two groups were fairly close on the fourth FCE test.

Table 3
Group L Scores on the First and the Fourth FCE Tests ($n = 9$)

Group	Student ID	First FCE Score	Fourth FCE Score
Low	F11	17	23
Low	F02	16	28
Low	F12	15	24
Low	F14	15	17
Low	F15	15	14
Low	F01	14	26
Low	M03	14	21
Low	M01	13	26
Low	F09	10	22
	<i>Mean</i>	14.33	21.78
	<i>SD</i>	1.89	4.05

Table 4
Group H Scores on the First and the Fourth FCE Tests ($n = 8$)

Group	Student ID	First FCE Score	Fourth FCE Score
High	M02	24	24
High	F16	23	22
High	F03	21	27
High	M04	21	24
High	F04	20	24
High	F05	20	26
High	F07	20	19
High	F10	18	28
	<i>Mean</i>	20.88	24.25
	<i>SD</i>	1.76	2.68

Table 5 shows the sum total of quiz scores and the number of access log entries of each student. To identify the correlation between the two sets of variables, the Spearman rank-correlation was used, and the results indicated that there was a relatively strong relationship between them ($r_s = .61, r^2 = .37$). It is thus possible to maintain that the number of times the students visited the LMS may have influenced their achievement.

Table 5
Students' Quiz Scores and Total Number of Times Students Accessed the LMS
($N = 17$)

Student ID	Quiz score	Number of access times
F01	109.50	41
F02	128.00	71
F03	125.50	58
F04	92.50	26
F05	105.00	18
F07	106.10	42
F09	127.10	56
F10	128.40	24
F11	105.00	29
F12	115.50	26
F14	87.10	33
F15	70.60	25
F16	120.60	53
M01	52.50	20
M02	98.50	14
M03	78.24	14
M04	96.00	10

Table 6 summarizes the number of access log entries and FCE gain scores of each student. The FCE gain score was calculated by subtracting the first FCE score from the fourth FCE score. The Spearman rank-correlation was again used, and there was only a weak correlation between the two sets of data ($r_s = .14, r^2 = .02$). However, when the data set of Group H was omitted and then the Group L data were analyzed in the same way, a relatively strong correlation between the access log entries and the raw gain scores was found ($r_s = .59, r^2 = .35$). This result suggests that the number of times the students used the LMS may have influenced their FCE gain scores in Group L.

Table 6

Total Number of Times LMS was Accessed and the FCE Gain Scores ($N = 17$)

Group	Student ID	Number of times LMS accessed	FCE gain
High	M02	24	0
High	F16	53	-1
High	F03	58	6
High	M04	10	3
High	F04	26	4
High	F05	18	6
High	F07	42	-1
High	F10	24	10
Low	F11	29	6
Low	F02	71	12
Low	F12	26	9
Low	F14	33	2
Low	F15	25	-1
Low	F01	41	12
Low	M03	14	7
Low	M01	20	8
Low	F09	56	12

3.4.2 Changes in the instructor's teaching methods

A part of the Grounded Theory Approach procedure (Corbin & Strauss, 2008, Chapters 8 and 9) was used to classify the video data of the lessons. As a result, the following four categories were generated:

1. Quiz
2. One-way Instruction
3. Interactive Instruction
4. Activity

The "Quiz" category includes time in which quizzes were conducted at the beginning of each lesson. "One-way Instruction" refers to the period of time in which the instructor elaborated on the reading materials or related issues in one-way instruction in English. "Interactive Instruction" includes time in which the course instructor and students interacted directly, that is, the instructor asked questions and the students answered, or vice versa. Lastly, "Activity" refers to time in which students engaged in activities related to the lessons such as sharing information about the reading materials or helping each other understand the materials. Table 7 presents the results of categorization of the video data.

Table 7

Categorization of Video Data in Hours, Minutes, and Seconds (h:m:s)

	Quiz	One-way Instruction	Interactive Instruction	Activity
First semester	2:30:16 (18.55%)	4:33:47 (33.80%)	2:44:14 (20.28%)	3:41:43 (27.37%)
Second semester	2:09:46 (20.60%)	3:44:12 (35.59%)	3:06:18 (29.57%)	1:29:44 (14.24%)
Total	4:40:02 (19.45%)	8:17:59 (34.58%)	5:50:32 (24.34%)	5:11:27 (21.63%)

As Table 7 shows, the instructor's methods of conducting the lesson seemed to be fully interactive and cooperative. The period of time that the instructor spent on "Interactive Instruction" accounted for 24.34% of the total lesson time. During the "Interactive Instruction," students spontaneously gave their opinions in response to the instructor's questions, and he helped them complete their utterances in English in a variety of ways by offering scaffolding. In addition, "Activity" time, in which students were allowed to learn individually or cooperatively, amounted to 21.63% of the total lesson time. "Interactive Instruction" and "Activity" together accounted for 45.97% of the total lesson time.⁴

Below is a scene from a lesson that was categorized as "Interactive Instruction." At the beginning of the lesson, the instructor asked a student a question related to the topic of the reading materials in the textbook.

- Instructor: What questions do you want to be asked?
 Student: About travel.
 Instructor: About traveling, OK. Do you like traveling very much?
 Student: Yes.
 Instructor: Why do you want to be asked about traveling?
 Student: I have many places to visit...
 Instructor: Ah-ha, you have many places that you want to go.
 Student: So, I want to be asked about it.
 Instructor: Where do you want to go?
 Student: New Zealand.
 Instructor: Why do you want to go to New Zealand?

⁴ The amount of time spent on "Interactive Instruction" and "Activity" together accounted for only 35.0% in other courses examined to obtain the baseline data for comparison. Although this figure was informal, we can note that there was a great difference between the course described in this study and other courses.

- Student: Because I heard the country is safe. I know some people from New Zealand. They are great people.
- Instructor: OK, the country is said to be safe. I don't know exactly, but the country is safe and people from there are nice to you.

In this interaction, the instructor elicited the student's utterances and offered scaffolding to facilitate the interaction. First, the instructor posed an open question to the student, who responded with a simple answer. Second, after hearing the student's answer, the instructor swiftly asked a follow-up question correcting her utterance and gave her another opportunity to answer his question: *Why do you want to be asked about traveling?* Third, he offered scaffolding to help her complete her sentences in English: *Ah-ha, you have many places that you want to go.* With the help of the course instructor, the student could complete her utterance. Lastly, the course instructor gave the student and class feedback on the student's comment, which helped her understand exactly how she could say what she wanted in English: *OK, the country is said to be safe. I don't know exactly, but the country is safe and people from there are nice to you.* These "interaction frames" (Fogel, 1993), which started from a simple "Question and Answer" phase and finished at a "Feedback" phase through a "Scaffolding" phase, were observed many times during the lesson and established the teaching flow of the lessons.

This sample interaction reflects that the CML-based teaching practice ameliorated factors that hinder smooth interaction in LL/CALL classrooms and allowed the instructor the flexibility necessary to conduct student-centered activities while offering scaffolding to the students. As a result, the instructor successfully facilitated the student's use of the target language and elicited her participation in classroom activities.

In the interview, when the course instructor was asked why he was able to spend sufficient time on interactions and student-centered activities during the lesson, he commented as follows:

Since I started using the LMS in connection with the lesson, I was able to divide the contents into what I should teach during (in-class) lessons and what I can let the students study on the website. As a result, I was able to offer many student-centered activities within the lesson and give the students many opportunities to speak in English.

In another part of the interview, he also commented as follows:

I think the amount of time available for activities within a lesson drastically increased with the aid of the LMS, and the students seemed to enjoy learning and speaking up in English in activities. I also think that these positive experiences that the students had in the activities helped them maintain their focus throughout the course while studying English. These positive experiences also might have become the students' motivation for visiting the LMS after each lesson.

These comments, along with many similar comments obtained in the interview data, indicate that the instructor changed his teaching methods after he adopted the CML-based teaching practice.

The students also gave positive feedback on the CML-based teaching practice. In response to the questionnaire item, *Do you think it was good to do activities in the lesson?* 94.7% of them ($n = 18$) indicated “Absolutely agree” or “Agree.” In addition, to the question *Do you think there were sufficient opportunities to give your opinions in the lesson?* 89.5% of the students ($n = 17$) responded “Absolutely agree” or “Agree.”

3.4.3 Reflection

The results described above suggest that the CML-based teaching practice, which was designed, tested, and analyzed following the DBR framework by Amiel and Reeves (2008), helped improve students’ English ability as well as the course instructor’s teaching methods. Also, the CML-based practice expanded time and space for the class; the instructor could use the resources on the LMS as an “extended learning environment” (van Deusen-Scholl et al., p. 657), dividing the syllabus between what he should teach in class and what the students could study on the website. As a result, he could spend more time on student-centered activities in the lessons and offer the students numerous opportunities to speak English without having to worry about using technology in the classroom. The time and opportunities for student-centered activities in class may have contributed to eliciting the students’ participation in the lesson and to effectively guiding them to the learning materials in the LMS. This learning cycle seemed to help increase the number of students’ learning hours outside the lesson, which is indispensable for EFL learning, especially in the Japanese EFL context (Takeuchi, 2002). In addition, the course instructor’s teaching methods may have contributed to creating positive relationships among the students. Especially in Group L, this relationship helped them voluntarily participate in classroom activities.

In this study, however, the improvement of the Group H students was not statistically significant. A few students in Group H even scored lower in the raw gain result of the FCE tests, although their performances in relation to the number of access log entries and quiz scores was similar to that of the students in Group L. This may be because the ceiling effect influenced the Group H students’ performance on the FCE test scores.

3.4.4 Design principles

Based on the results of the implementation of the CML-based teaching practice through the four phases of the DBR framework, additional design principles for foreign language education in EFL context are identified as listed below.

1. Consider persons, classroom context, and tools as one interacting system for foreign language education.
2. Integrate in-class teaching practices with students’ out-of-class self-learning with the aid of technology.

3. Expand time and space for foreign language teaching and learning, especially in the EFL context.
4. Divide foreign language education into what instructors should teach in class and what they can allow students to do as out-of-class self-learning.
5. Facilitate interaction in class, offering students pedagogical scaffolding.
6. Guide students to out-of-class self-learning.

4. Conclusion

Before the conclusion of this paper, some limitations should be addressed. First, the ecological perspective was discussed here only from the teaching perspective. To discuss the ecological perspective in its full sense, the viewpoints of learners, school administrators, and software/hardware developers should be included as well. Second, the CML-based teaching practices were tested only with an LMS. To investigate a wider range of applicability, similar teaching practices should be designed and implemented with other types of technology, such as smartphones. Therefore, additional tests should be conducted in a different type of practice representing the Japanese EFL context. Finally, the method for investigating the influence of the CML-based teaching practice on the progress of students' English ability should be improved. In this study, a reading section of the FCE was administered four times. Although numerous efforts were made to minimize the expected negative impact of the repeated administration, using the same reading passage four times may still weaken the validity of the test results. For further improvement, a computer adaptive test or other standard tests that have consistent measurement across different versions should be considered.

Despite these limitations, the CML based on the DBR framework for foreign language education was successfully proposed. It was shown to have a positive influence on the improvement of students' English ability and the course instructor's teaching methods. In addition, six design principles were proposed. These principles will allow similar teaching practices to develop their own models and establish new design principles through successive iterative cycles of DBR.

Authors' Note

This chapter is dedicated to the memory of Dr. Leo van Lier.

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