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Enhancing Hong Kong Secondary Students' English Grammar Learning and Collaborative Problem-solving Skills with Productive Failure Instructional Design in a MCSCL Environment

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Abstract: In this paper, we proposed a productive failure instructional design (Kapur, 2008) to enhance Hong Kong secondary students' English grammar learning and collaborative problem-solving skills in a MCSCL environment. It is believed that the pedagogical implications of this study will make contributions to the technology-enhanced language learning field. In addition, insight gained from this study will hopefully extend to investigating the impact of productive failure pedagogical design on listening, speaking, writing, and reading skills in the L2 acquisition.

Keywords: Productive failure instruction, grammar learning, collaborative learning, MCSCL

1. Introduction

English grammar is the foundation for communication. Based on Hong Kong English Language Education Key Learning Area Curriculum Guide (Curriculum Development Council, 2017), grammar should be learned through text, providing opportunities for students to explore the grammatical features in an authentic learning context and develop generic skills.

The integration of mobile technology into grammar learning in the L2 has offered an opportunity to create a language learning environment which cannot be realized in a traditional classroom. But the majority of mobile-assisted language learning studies have focused on individual learning as opposed to collaborative learning and have tended to be teacher-centred (Burston, 2014).

Among student-centred approaches, problem-based learning (PBL) serves an instructional learning strategy for better understanding concepts in authentic context (Hung, 2013). English grammar learning, when related to the use in real-life contexts or context-appropriate lexico-grammatical rules, is often ill-structured and hence ideal for PBL instruction in L2. Thus, how to design problem solving tasks in language learning becomes an important issue. "Productive failure (PF)" pedagogical design, proposed by Kapur (2008), argued that support and consolidation should be delayed for students in unguided problem-solving. Kapur's PF studies have been replicated in the world (Pathak et al., 2011; Kapur & Rummel, 2012; Mazziotti, Loibl, & Rummel, 2015; Song & Kapur, 2017; Song, 2018) and proved that PF could be effectively used among learners of various abilities and both well-structured and ill-structured learning tasks. However, no study has been found in applying the "Productive failure (PF)" pedagogical design into language learning.

This study is the first attempt to investigate the effectiveness of PF pedagogical design in English grammar learning in examining the secondary students' grammar competence enhancement and collaborative problem-solving skills.

2. Relevant Literature Review

"Productive failure instruction design" was proposed by Kapur (2008). It is a pedagogical design that entails the design of problems for learners to engage in "generation and exploration", followed by a consolidation phase or instruction (see Figure 1).

The productive failure instruction design consists of two phases (Kapur & Bielaczyc, 2012, p.49): (1) Phase 1 affords opportunities for students to generate and explore the affordances and constraints of multiple representations and solution methods (RSMs); (2) Phase 2 affords organizing and assembling the relevant student-generated multiple representations and solution methods into canonical RSMs.

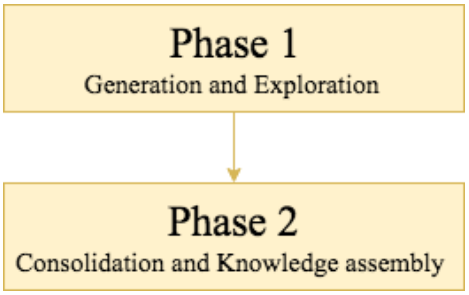

***Figure 1*. Productive Failure Instruction Design (Kapur & Bielaczyc, 2012)**

Many studies based on productive failure instructional design have found that when consolidation was delayed, learners were able to perform better when compared those within direct instruction (Kapur, 2010; Kapur, 2011; Kapur, 2014). Kapur (2010) conducted a study in Singapore secondary school to investigate the effectiveness of PF in mathematical problem solving and found that students from the productive failure condition significantly perform better than those from the lecture and practice (LP) condition. One year later, he extended his study in three conditions and affirmed the effectiveness of PF that students from PF significantly performed better than those in the facilitated complex problem-solving conditions (Kapur, 2011). Furthermore, Song and Kapur (2017) proposed "productive-failure based flipped classroom" pedagogical design and tested the effectiveness of productive failure instruction design for mathematical learning in Hong Kong secondary school. Song's study (2018) on Hong Kong primary students' collaborative problem-solving competency in project-based science learning with PF instructional design also proved that PF could help students gain a deeper understanding of conceptual science knowledge and improve collaborative problem-solving skills.

However, the majority of studies using productive failure instructional design have been conducted in mathematics learning (Kapur 2010, 2011, 2014; Westermann & Rummel, 2012; Loibl & Rummel 2014; Mazziotti, Loibl & Rummel, 2015; Song & Kapur, 2017; Loibl, Roll, & Rummel, 2017), some studies were conducted in science learning (Kapur & Kinzer, 2009; Song, 2018). Studies adoping productive failure instructional design have hardly been found in language learning, not to mention studies in technology-enhanced collaborative learning environments.

3. This Study

3.1 Research Questions

In order to investigate the effectiveness of productive failure instructional design in grammar learning and collaborative problem-solving skills in mobile computer-supported collaborative learning (MCSCL) environment, the following three research questions are going to be addressed in this study:

- Research Question 1: What is the impact of productive failure instructional design on students' grammar learning in MCSCL environment?
- Research Question 2: What is the impact of productive failure instructional design on students' problem-solving skills in MCSCL environment?
- Research Question 3: What are students' perceptions of productive failure instructional design (PFI) in grammar learning?

3.2 Research Design

In this study, Padlet will be used as the primary learning platform (https://padlet.com/, see Figure 2). Padlet offers an excellent venue for students to share their thoughts and modify them. Besides, it allows students to post many kinds of files like a web link, text, videos, and images to Padlet notes, which makes students' thinking visible.

Participants will be divided into two groups, one is the experimental group, in which productive failure instructional design (PFI) will be used in MCSCL environment. While in the control group, participants will be involved in direct instructional design (DI) in MCSCL environment.

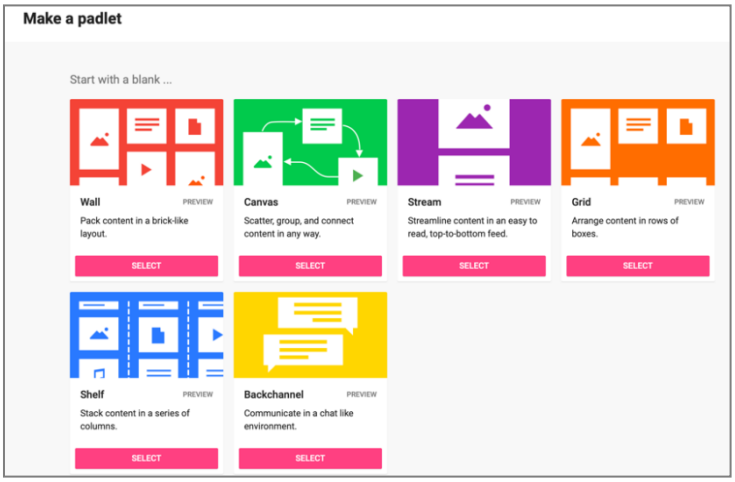

Figure 2. **Proposed MCSCL Environment -Padlet**

3.3 Methods

3.3.1 Participants and Learning Topics

A quasi-experimental design method will be adopted in this study. Three secondary English teachers with six classes of Grade seven from three government secondary schools in Hong Kong will be involved. Three schools with students are above the average, average and below the average (Band 1, 2, 3 in Hong Kong) will be selected to test the scalability of productive failure instructional design in mobile computer supported collaborative language (MCSCL) learning environment. Participants have the experience of using mobile technology to support learning. Three teachers selected should have at least five years of working experience and are willing to accept innovative pedagogical practices and embrace challenges of technology-enhanced language learning.

In the quasi-experiment study, one class is the experimental group which will adopt "productive failure instructional design" (PFI), while the other is the control group which will adopt "direct instructional design" (DI). Each teacher will be responsible for two classes in this study. Each class will be divided into five or six groups, learning styles and performances of students will be taken into consideration when grouping because a study conducted by Saleh et al. (2007) shows that structuring collaboration in mixed-ability groups could promote verbal interaction, learning, and motivation of students. Grammar knowledge included in this study will be "simple past tense", "simple present tense", "simple future tense" and "comparative/superlative".

3.3.2 Study Procedure

All the experimental groups in three schools will adopt productive failure instructional design, while the control group does not adopt the design (see Figure 3). Firstly, students will be given pre-tests to assess if they have prior knowledge of target grammar. Following that, all students in control groups and experimental groups are expected to be provided with the same learning materials, tasks and allocated time.

Productive failure instruction consists of two phases (Kapur & Bielaczyc, 2012), "a generation and exploration phase" followed by "consolidation phase". Students in experimental groups (PFI) are expected to solve problems related to the target grammar points in groups at the beginning of the class

(the problem is scenario-based presented on mobile devices, see Figure 4). For example, they will be required to watch the video about "The Story of Hong Kong" (e.g., in learning "simple present tense") on Padlet. In the video (see Figure 5), all important grammar points will be highlighted. Right grammatical use will be highlighted in red and wrong grammatical use will be highlighted in green. Students are encouraged to guess the use of "simple present tense" and correct the wrong sentence in the video on Padlet collaboratively (see Figure 6). During the process of solving the problem, teachers will give the necessary support, but will not tell students correct answers. Following that, each group will present their findings. They can see peers' ideas and findings on Padlet at the same time. In Phase 2, the teacher could compare groups' findings and make conclusions. At the end of the class, the teacher will elaborate on the rules of target grammar explicitly.

Students in control groups (DI) will involve in direct instruction. The teacher will introduce the rules of grammar at the beginning of the class. Then students solve problems in groups using the iPad (the problem is scenario-based presented on mobile devices, see Figure 4). Students will be expected to watch the video related to the grammar (see Figure 5) and solve the problem collaboratively (Figure 6). After that, the teacher provides feedback and summarizes grammatical rules at the end of the class.

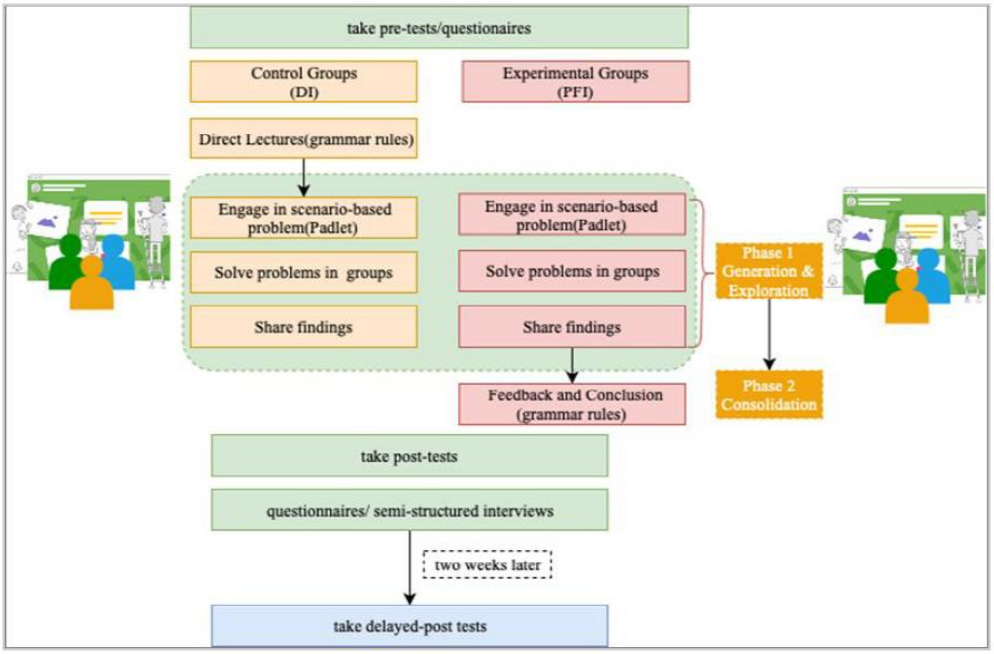

Figure 3. **The Study Procedure**

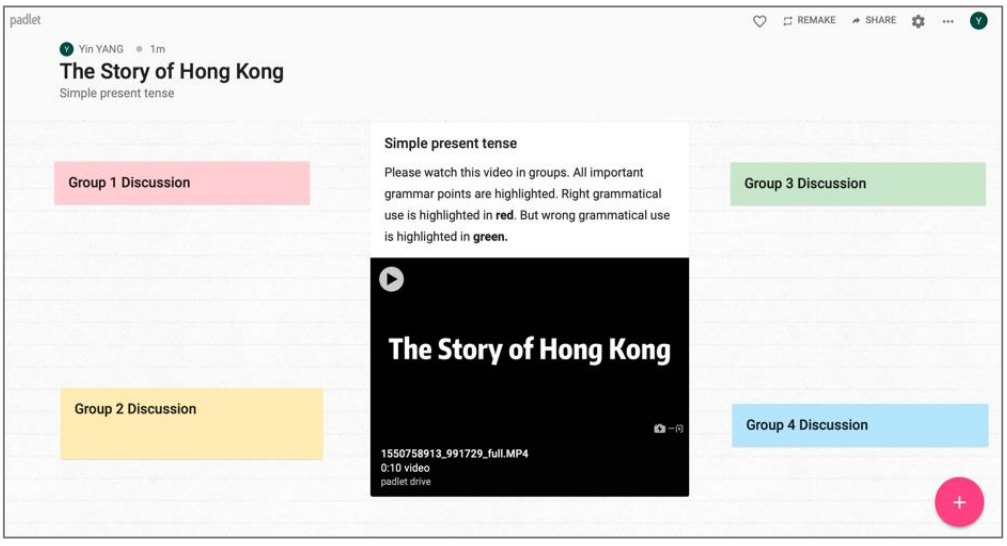

Figure 4. **The Interface of "Scenario-based Problem" on Padlet**

Figure 5. Screencast of "Scenario-based Problem"

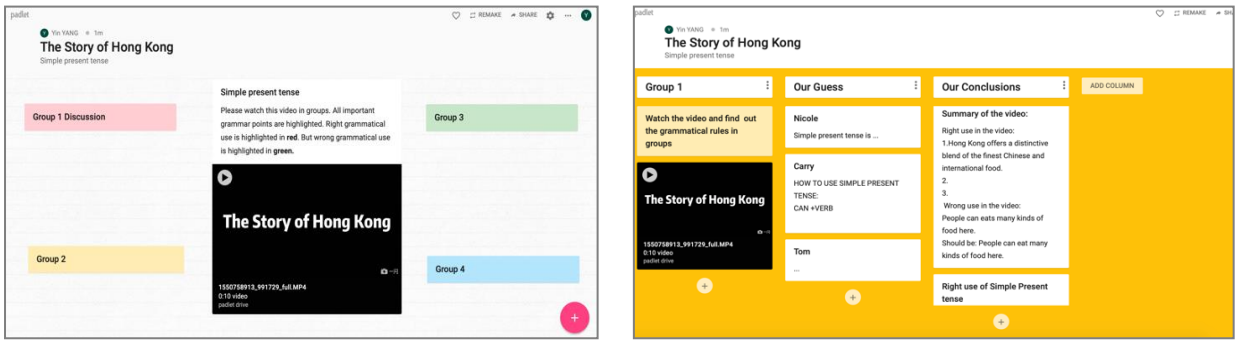

Figure 6. Collaborative Learning on Padlet

3.3.3 Data Collection and Analysis

Mixed research method will be adopted in this study. Both qualitative and quantitative data will be collected and analyzed, which include pre-and post-tests, delayed post-tests, students' logged data on Padlet, pre-and post-questionnaires and semi-structured interviews (see Table 1).

Student's logged data on Padlet will be recorded and analyzed using the coding scheme of for collaborative activities proposed by Erkens and Janssen (2008). Students' interviews will be recorded and analyzed. Quantitative data analysis of pre-and post-tests, delayed-post tests, and pre-and post-questionnaires will be conducted using SPSS version 25.

Table 1
Instruments to Address Research Questions

	Question 1	Question 2	Question 3
Pre-and post-tests, delayed post-tests	√		
Pre-and post-questionnaires		√	√
Students' logged data on Padlet		√	
Semi-structured interviews			√

4. Significance

The study is the first attempt in applying productive failure instructional design into language learning pedagogical practice in a MCSCL environment. The contribution of this project helps: (1) To improve Hong Kong secondary learners' grammar knowledge achievement and problem-solving skills in a MCSCL environment; and (2) to extend the application of productive failure (PF) instructional design in language teaching and learning in MCSCL environment.

References

Burston, J. (2014). MALL: The pedagogical challenges. *Computer Assisted Language Learning*, *27*(4), 344-357.

Curriculum Development Council (Hong Kong, China). (2017). *English Language Education: Key Learning Area Curriculum Guide (Primary 1-Secondary 3)*. Curriculum Development Council. Retrieved from https://www.edb.gov.hk/attachment/en/curriculum-development/kla/eng-edu/Curriculum%20Document/ELE%20KLACG_2017.pdf

Erkens, G., & Janssen, J. (2008). Automatic coding of dialogue acts in collaboration protocols. *International journal of computer-supported collaborative learning*, *3*(4), 447-470.

Hung, W. (2013). Problem-based learning: A learning environment for enhancing learning transfer. *New directions for adult and continuing education*, *2013*(137), 27-38.

Kapur, M. (2008). Productive failure. *Cognition and instruction*, *26*(3), 379-424.

Kapur, M., & Kinzer, C. K. (2009). Productive failure in CSCL groups. *International Journal of Computer-Supported Collaborative Learning*, *4*(1), 21-46.

Kapur, M. (2010). Productive failure in mathematical problem solving. *Instructional Science*, *38*(6), 523-550.

Kapur, M. (2011). A further study of productive failure in mathematical problem solving: Unpacking the design components. *Instructional Science*, *39*(4), 561-579.

Kapur, M. (2014). Productive failure in learning math. *Cognitive Science*, *38*(5), 1008-1022.

Kapur, M., & Bielaczyc, K. (2012). Designing for productive failure. *Journal of the Learning Sciences*, *21*(1), 45-83.

Kapur, M., & Rummel, N. (2012). Productive failure in learning from generation and invention activities. *Instructional Science*, *40*(4), 645-650.

Loibl, K., & Rummel, N. (2014). Knowing what you don't know makes failure productive. Learning and Instruction, 34, 74-85.

Loibl, K., Roll, I., & Rummel, N. (2017). Towards a theory of when and how problem solving followed by instruction supports learning. *Educational Psychology Review*, 29(4), 693–715.

Mazziotti, C., Loibl, K., & Rummel, N. (2015). Collaborative or Individual Learning within Productive Failure: Does the Social Form of Learning Make a Difference?. International Society of the Learning Sciences, Inc.[ISLS]..

Pathak, S. A., Kim, B., Jacobson, M. J., & Zhang, B. (2011). Learning the physics of electricity: A qualitative analysis of collaborative processes involved in productive failure. *International Journal of Computer-Supported Collaborative Learning*, *6*(1), 57-73.

Saleh, Mohammad, Lazonder, Ard W., & Jong, Ton de. (2007). Structuring Collaboration in Mixed-Ability Groups to Promote Verbal Interaction, Learning, and Motivation of Average-Ability Students. *Contemporary Educational Psychology*, *32*(3), 314-331.

Sánchez, J., & Olivares, R. (2011). Problem solving and collaboration using mobile serious games. *Computers & Education*, 57(3), 1943-1952.

Song, Y. (2018). Improving primary students' collaborative problem solving competency in project-based science learning with productive failure instructional design in a seamless learning environment. *Educational Technology Research and Development*, *66*(4), 979-1008.

Song, Y., & Kapur, M. (2017). How to Flip the Classroom-" Productive Failure or Traditional Flipped Classroom" Pedagogical Design?. *Journal of Educational Technology & Society*, 20(1), 292.

Westermann, K., & Rummel, N. (2012). Delaying Instruction: Evidence from a Study in a University Relearning Setting. *Instructional Science: An International Journal of the Learning Sciences*, *40*(4), 673-689.