DO ENGLISH LISTENING OUTCOME AND COGNITIVE LOAD CHANGE FOR DIFFERENT MEDIA DELIVERY MODES IN U-LEARNING?

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ABSTRACT

Although ubiquitous learning enhances students' access to learning materials, it is crucial to find out which media delivery modes produce the best results for English listening comprehension. The present study examined the effect of media delivery mode (sound and text vs. sound) on English listening comprehension and cognitive load. Participants were 162 students majoring in Applied Foreign Language at a university in Taiwan. The students were randomly assigned to either single mode (sound) or double mode (sound and text). The research questions are (a) whether students learning with double mode outperformed students learning with single mode in listening comprehension; and (b) whether students learning with double mode hold less cognitive load than students learning with single mode. If the answers to these questions are affirmative, then the modality effect occurs and the redundancy effect does not occur. The results demonstrated that (a) text significantly enhanced English listening comprehension and lowered cognitive load; (b) students with higher English listening comprehension held lower cognitive load, and vice versa; (c) text was added no benefit to schema construction in long-term memory; and (d) complex media deliveries were not necessarily helpful to learning. Results (a) and (b) confirmed that the modality effect occurred, and the redundancy effect did not occur in the present study.

KEYWORDS

U-Learning, Media Delivery Mode, English Listening, Cognitive Load

1. INTRODUCTION

1.1 Background

Listening comprehension is difficult for foreign language learners because it is a continuous process that requires learners to understand messages while listening to them and sometimes can lead to a heavy cognitive load. In order to get rid of listening barriers, various media delivery modes and ubiquitous learning activities should be implemented in the instruction because they are convenient and can enhance students' learning motivation and learning performance (Liu & Chu, 2010). Ubiquitous learning involves a context-aware environment that users engages in with some mobile devices (Tan, Liu, & Chang, 2007). Hence, learners learning in an authentic situation will have better English listening comprehension due to the enhanced sensory stimulation.

The impacts of different media delivery modes on learning remain inconclusive. According to the working memory model proposed by Baddeley (2000), working memory can simultaneously receive information from different channels, such as auditory and visual. Thus, when the efficiency of the working memory is improved, learning performance will also be enhanced. However, Kalyuga, Chandler and Sweller (2000) suggested that some multimedia learning software can lead to cognitive load, which affects learning performance negatively. Sweller (2005) also argued that unnecessary or repeated multimedia messages can result in a redundancy effect, which negatively affects learning performance.

Multimedia helps learners learn, but different media delivery modes affect learners' cognitive load differently (Mayer & Moreno, 2003; Plass, Chun, Mayer, & Leutner, 2003). Sweller (2007) mentioned that the purpose of instructional design is to assist learners to store information in long-term memory. This implies that the way teaching materials presented to learners is a key to instructional design. Attention to cognitive load is a critical concern for instructional designers when designing multimedia teaching materials because unnecessary multimedia messages will worsen learning performance by increasing working memory load and interrupting information processing (Sweller, 2007).

Multimedia instructional systems have been widely applied in teaching and learning, but the media delivery mode that is best for English listening comprehension remains uncertain, and whether unnecessary information led to cognitive load for learners also remains inconclusive. According to the studies done by Jones and Plass (2002) and Diao, Chandler and Sweller (2007), learners learning with double mode (sound and text) outperformed learners learning with single mode (sound) and had lower cognitive load. Studies related to foreign language learning and cognitive load are mostly about digital learning environments. Hence, the present study examined the effect of media delivery mode on listening comprehension in a ubiquitous learning environment to see if there were any differences from the studies on digital learning environments. Which media delivery mode can efficiently help learners store information in long-term memory is another issue to be further examined.

1.2 Research Purpose and Questions

The present study aimed to examine the effect of media delivery mode (single mode: sound; double mode: sound and text) on English listening comprehension and cognitive load in a ubiquitous learning environment. The research questions include:1.Are there any significant differences in English listening comprehension between two media delivery modes? 2.Are there any significant differences in cognitive load between two media delivery modes? 3.Are there any significant correlations between English listening comprehension and cognitive load?

2. METHOD

2.1 Participants

Participants were 162 university students in Taiwan, aged from 18 to 23, majoring in Applied Foreign Language with the same instructor. These participants were randomly assigned to either single mode group or double mode group. There were 82 students in the single mode group and 80 students in the double mode group. The participants had similar academic proficiency because all students had been assigned to the university based on their scores obtained from the Joined College Entrance Examination. Before the experiment started, all the participants had been familiarized with PDA.

The ubiquitous learning activity in the present study was held at the Taipei Zoo. The Taipei Zoo is one of the main Natural Science Education centers in Taiwan, where people can acquire knowledge about animals and nature. Since the topic of the learning activity was related to animals, it was more appropriate for learners to learn in the zoo. Learning in the zoo enabled learners to experience an experiential learning. With the support of PDA, teaching efficiency and learning motivation are enhanced, which can be a contribution to education. The possible career opportunities for students majoring in Applied Foreign Language are tour guides, who can speak more than one second language, and foreign language teachers. So, the experiment in the present study provided an opportunity for the participants to visit the future workplace.

2.2 Research Design

The independent variable in the present study was media delivery mode, which were single mode (sound only) and double mode (sound and text). The dependent variables were learners' English listening comprehension and cognitive load. There were two tests in the present study. The first test was administrated to the participants immediately after the ubiquitous learning activity was over for examining their listening

comprehension. The covariate variable was English listening proficiency which was examined by General English Proficiency Test (GEPT).

As shown in Table 1, participants in both groups took GEPT as the pretest. In the ubiquitous learning activity, participants in the single mode group learned with sound-only materials and the double mode group learned with sound-and-text materials. After the learning activity, both groups took English listening tests and cognitive load questionnaire as the posttest.

Table 1. Research design (ubiquitous learning)

Group	N	Pretest	Experiment	Posttest
Single	82	General English Proficiency Test (GEPT)	Sound-only English listening material	English listening test Cognitive load
Double	80		Concurrently sound and text English listening material	

2.3 Research Design

There were four stages in the experiment including pretest (first week), training (second week), and intervention and posttest (third week), as shown in Table 2.

Table 2. Research design

Stage	Description
Pretest (First week)	The pretest was administrated during the class (1.5 hours): 1. The instruction for the test was given by the instructor (0.5 hour). 2. Students took listening test from GEPT (1 hour).
Training (Second week)	The training was provided during the class (3 hours): 1. Introduction of ubiquitous learning, PDA (HP IPAQ 112 Classic, 3.5 inch screen) and GPS, including practical experience on using PDA and GPS. 2. Instructor provided key words that would be included in the material.
Intervention and Posttest (Third week)	Ubiquitous learning and test in the zoo (4 hours): 1. Students were randomly assigned into two groups with either single or double mode material. 2. Students had their PDA to be connected with GPS. 3. The system asked students to enter their student ID. 4. Exploration of animals would be displayed on the screen. Students could see the map of Africa area in the zoo and their current location. Each animal was marked on the map and students could decide the listening order by their preferences. The system guided students to the target by GPS. 5. When students arrived in the observed area, the system would display its material automatically by GPS and ask students if they wanted to start the listening or not. 6. Students were presented to English listening material by clicking on the button "Play". 7. After the speech sound played, students needed to click on the button "Next Page" for the test page. 8. After taking the test, students would then continue to the next animal with the steps mentioned above. 9. Students were required to fill-in the cognitive load rating scale.

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2.4 Instrument

2.4.1 English Listening Proficiency Test

The General English Proficiency Test (GEPT) was utilized in the present study to determine students' proficiency in English listening since the GEPT was a graduation requirement for the students majoring in Applied Foreign Language. There were 20 multiple-choice questions given by sound speech in the test. Each question was worth five points, and the total possible score for the test was 100.

2.4.2 English Listening Material and Test

A total of four animals, including elephant, lion, monkey and giraffe, were chosen from the Africa area in the Taipei Zoo. Each animal was described by a passage, so there were a total of four passages in the test. The English listening training system was developed by the research team in the present study. The content of the teaching material and the test were adapted from the website of National Geographic (http://animals.nationalgeographic.com/) and San Diego Zoo (http://www.sandiegozoo.org/animalbytes/index.html), as shown in Figure 1 and 2. The spoken time for each passage, with length from 180 to 220 words, was about three minutes. There were five multiple-choice questions for each passage, which required students to answer (without time restriction) after listening to each passage. There were 20 questions in the test and one point for each question.

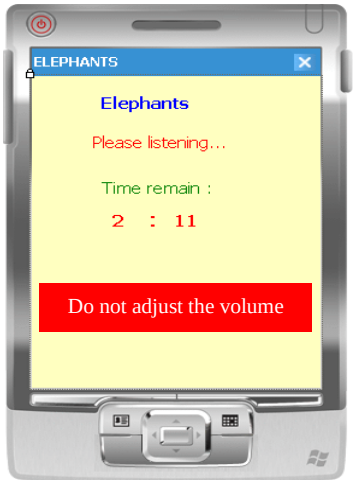

Figure 1. PDA screen of single mode

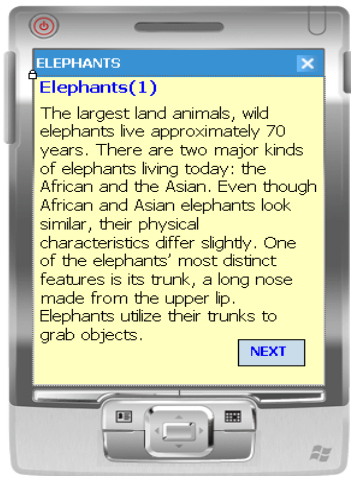

Figure 2. PDA screen of double mode

2.4.3 Cognitive Load Rating Scale

The cognitive load rating scale by Yeung, Lee, Pena, and Ryde (2000) was adopted in the present study, as shown in Table 4. The rating scale included four aspects, which were difficulty, incompetence, negative affect and lack of effort. The reliability for each aspect was ranged from 0.78 to 0.93, which was acceptable. The factor loadings for all the items were greater than 0.5 and the four factors accounted for more than 50% of total explained variance. Therefore, the validity of the rating scale was satisfied. The participants were required to rate themselves on a 5-point Likert-type scale with response options from 1 (extremely agree) to 5 (extremely disagree). The reliability coefficient of the measures of cognitive load was .814, as measured by Cronbach's α, which was acceptable.

3. RESULT AND DISCUSSION

3.1 The Effect of Media Delivery Mode on English Listening Comprehension and Cognitive Load (Research Question 1 and 2)

As shown in Table 3, for English listening comprehension, learners in the double mode group outperformed learners in the single mode group. For cognitive load, learners receiving single mode possessed higher level than learners receiving double mode. As shown in Table 4, Wilk's Λ showed a significant result, indicating that learners in both groups had significant differences in at least one dependent variable (English listening comprehension or cognitive load). The analysis of two-way MANCOVA, with covariance of English listening proficiency, showed that there was a significant difference in listening comprehension ($p < .05$) between the two groups, indicating that learners in the double mode group outperformed learners in the single mode group. There was a significant difference in cognitive load ($p < .05$) between the two groups, revealing that the single mode group had higher cognitive load than the double mode group. Both groups had significant differences in listening comprehension and cognitive load, but the estimated effect size for listening comprehension ($\eta^2 = 0.117$) was greater than cognitive load ($\eta^2 = 0.033$). This implied that media delivery mode had more impacts on listening comprehension than on cognitive load, and both groups had more differences in listening comprehension than in cognitive load.

Table 3. Descriptive statistics for listening comprehension and cognitive load

Aspect	Single mode		Double mode	
	M	SD	M	SD
English listening comprehension	6.667	1.916	8.099	2.262
Cognitive load	51.617	20.458	44.621	19.907

Table 4. Two-way MANCOVA summary on listening comprehension and cognitive load

Wilk's Λ (Sig.)	Source	Aspect	Type III Sum of Squares	df	Mean Square	F	Sig.	Eta. Squared
0.877 (0.000)	Covariance	Listening comprehension	66.780	1	66.780	16.878*	0.000	0.112
		Cognitive load	6183.521	1	6183.521	16.993*	0.000	0.113
	Between-group	Listening comprehension	70.070	1	70.070	17.709*	0.000	0.117
		Cognitive load	1671.568	1	1671.568	4.594*	0.034	0.033
	Within-group	Listening comprehension	530.197	134	3.957			
		Cognitive load	48760.674	134	363.886			
	Total	Listening comprehension	8187.000	137				
		Cognitive load	372151.143	137				

*$p < 0.05$

3.2 The Correlation between English Listening Comprehension and Cognitive Load (Research Question 3)

A Pearson Correlation was performed in the present study to examine if there was a correlation between English listening comprehension and cognitive load. English listening comprehension and cognitive load had a significant negative correlation ($r = -0.393$，$p < 0.001$).

In ubiquitous learning environment, learners who performed well in English listening comprehension held lower cognitive load, and vice versa. This result supported the cognitive load theory and confirmed most study results on cognitive load (Chung, 2008; Diao et al., 2007；Diao & Sweller, 2007；Jones & Plass, 2002) that learners had low cognitive load performed well.

3.3 Discussions

In the ubiquitous learning environment, learners in the single mode group held higher extraneous cognitive load due to the lack of text support. On the other hand, learners in the double mode group possessed lower extraneous cognitive load because they got the support from text. To some learners learning with double mode, they only needed to overcome intrinsic cognitive load from the material itself. Hence, learners learning with double mode outperformed learners learning with single mode. For the double mode, the modality effect occurred, but the redundancy effect did not. These results confirmed some study results on cognitive load (Diao, et al., 2007; Jones & Plass, 2002). A study by Chung (2008) revealed that learners with high English proficiency held lower cognitive load when they learned with double mode. So, the result in the present study that learners who learned with double mode had lower cognitive load could be explained by their sufficient English proficiency. Based on the result of the present study, text enhanced students' listening comprehension and lowered their cognitive load. At the same time, the result also confirmed the viewpoint by Baddeley (2000) that information could be received from both visual and auditory channels for increasing the capacity of the working memory and helping students learn, which referred to the modality effect from the cognitive load theory (Sweller, 2005).

4. CONCLUSION AND IMPLICATION

Although text significantly enhances English listening comprehension, learning without reviews is difficult for learners to build up schema in long-term memory. So, instructors who taught English listening are suggested to provide teaching materials with double mode (simultaneous sound and text) for facilitating learners' listening comprehension. After the listening class is over, instructors should provide review materials with single mode (sound only) for assisting students to build up schema.

English listening comprehension and cognitive load held a significant negative correlation. Based on some relevant studies (Pawley, Ayres, Cooper, & Sweller, 2005; Paas et al., 2003), extraneous cognitive load can be lowered by appropriate instructional designs and learning activities. So, instructors should pay much attention to the impact of cognitive load because learners without unnecessary information in the working memory learn efficiently.

The comparisons among single mode, double mode and triple mode, such as sound, text and image, with different learning environments, including traditional learning and multimedia digital learning, can be included in the future studies. Also, the presentation modes of text can be further categorized into synchronization and non-synchronization to examine the effect of text presentation mode on learning performance and cognitive load. For cognitive load, extraneous cognitive load can be lowered easily by instructional design, so it is appropriate to be a dependent variable in the experiment. Therefore, the present study focused only on examining the effect of two different presentation modes on extraneous cognitive load. Intrinsic cognitive load and germane cognitive load can be considered as the other dependent variables in the future studies.

Learners' prior knowledge or proficiency would be a main factor for determining an appropriate media delivery mode for learners (Chung, 2008). English proficiency was a covariance in the present study. Prior knowledge or learners' characteristics, such as learning styles and media preference, can be other independent variables in the future study. Furthermore, the interaction between learners' prior knowledge and media delivery mode and its effects on learning performance and cognitive load with two-way ANOVA were suggested for the future studies.

The ubiquitous learning activity in the present study was held outdoors, so some students' listening comprehension would be influenced negatively by the crowd, weather or any other exterior factors. Researchers are suggested to hold outdoor learning activities on campus for the future research. If researchers hold the learning activity in a public place, then hold on non-holidays for preventing unexpected interruptions.

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