Is single or dual channel with different English proficiencies better for English listening comprehension, cognitive load and attitude in ubiquitous learning environment?

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ABSTRACT

The purpose of the present study was to examine the effects of English proficiency (low vs. high) and material presentation mode (single channel vs. dual channel) on English listening comprehension, cognitive load and learning attitude in a ubiquitous learning environment. An experimental learning activity was implemented using PDA as a learning tool to facilitate learning. A quasi-experimental design was employed with university students participating in the experiment. The results revealed that (a) high English proficiency learners had significantly better English listening comprehension and lower intrinsic and extraneous load than low English proficiency learners; (b) both high and low English proficiency learners learning with dual channel had significantly better English listening comprehension and held more positive attitude toward the ubiquitous learning environment than learners learning with single channel; (c) for learners learning with single channel, low English proficiency learners had significantly higher extraneous load than high English proficiency learners; and (d) for low English proficiency learners, learners who learned with dual channel possessed significantly lower extraneous load than learners who learned with single channel. The suggestions for educators and instructional designers were also discussed in the present study.

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1. Introduction

Listening comprehension is crucial to language learning (Vandergrift, 2007), so having good listening comprehension is a key for non-native English speakers study English. Although auditory input is a main stimulus for listening comprehension, many researchers try to add text messages as visual input to enhance participants' listening comprehension in their studies. For example, studies by Huang and Eskey (2000), Markham (2001) and Bird and Williams (2002) supported that captions (text messages) can facilitate learners' listening comprehension. Captions are usually presented and supported by multimedia. Although there are many relevant studies about learning with multimedia, the impact of multimedia on learning still remains inconclusive (Bhowmick, Khasawneh, Bowling, Gramopadhye, & Melloy, 2007). According to the working memory model proposed by Baddeley (2000), working memory can receive information coming from various sources, such as visual and auditory input. Information that is received from different inputs is processed by different units in a human brain, so the efficiency of the working memory, as well as the learning performance, can be enhanced. However, Kalyuga, Chandler, and Sweller (2000) showed that synchronous text and spoken messages during learning can negatively affect learning performance due to cognitive load. Furthermore, most researchers hold experimental learning activities regarding listening comprehension in traditional classrooms and do not take students' English proficiency into account when designing learning activities (Winke, Gass, & Sydorenko, 2010). In order to get rid of learning barriers faced by English as a foreign language (EFL) students during their learning, multimedia and ubiquitous learning activity should be implemented into instruction because the multimedia and ubiquitous learning environment facilitate learning performance and learning motivation (Liu & Chu, 2010). Therefore, the present study aimed to examine the effects of English proficiency and material presentation mode on listening comprehension, cognitive load and learning attitude in a ubiquitous learning environment. The research questions include:

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1 . In the ubiquitous learning environment, will different material presentation modes (single channel vs. dual channel) and different English proficiencies (low vs. high) significantly affect English listening comprehension?

2. In the ubiquitous learning environment, will different material presentation modes (single channel vs. dual channel) and different English proficiencies (low vs. high) significantly affect cognitive load (intrinsic and extraneous)?

3. In the ubiquitous learning environment, will different material presentation modes (single channel vs. dual channel) and different English proficiencies (low vs. high) significantly affect learning attitude?

2. The theoretical framework

2.1. Ubiquitous learning and listening

Winke et al. (2010) indicated "with a greater emphasis on technology in language classrooms, the use of captioning will undoubtedly increase in importance and frequency" (p. 82). Although many studies developed mobile language learning environments effectively to aid listening, rare studies focused on investigating the use of context-aware ubiquitous learning environments in improving the English listening of university students in non-English-speaking countries (Liu & Chu, 2010). According to researchers (Chang, Sheu, & Chan, 2003; Li, Zheng, Ogata, & Yano, 2005; Tan, Liu, & Chang, 2007), ubiquitous learning environments provide teaching materials for learners to retrieve at the right time and in the right place, meaning that learners learn by a mobile device with context-aware system through a wireless network. Chang et al. (2003) mentioned three elements for ubiquitous learning, including mobile devices (e.g. PDA, Web Pad and Tablet PC), communication equipment (e.g. GPS) and learning activity. Therefore, participants in the present study engaged in the learning activity by using PDA as a learning tool to receive information through wireless networks and GPS.

Chen, Kao and Sheu (2005) pointed out six features for ubiquitous learning, including initiative of knowledge acquisition, mobility of learning setting, urgency of learning need, interactivity of learning process, integration of instructional content and situating of instructional activity. These features are beneficial to foreign language learners by eliminating limitations of time and space. Learners who study a foreign language with a mobile device in a ubiquitous learning environment are able to experience learning from an authentic situation, which enhances their learning performance (Nash, 2007). Some study results (Chen & Chung, 2008; Liu & Chu, 2010), with the subject matter on English vocabulary and conversation, showed that ubiquitous learning environments did improve learners' learning performance, and those participants also expressed that the ubiquitous learning environment enhanced their learning motivations. However, studies related to ubiquitous foreign language learning (Chen & Chung, 2008; Cui & Bull, 2005; Liu & Chu, 2010) focused mainly on vocabulary and conversation, so researchers in the present study focused the study on listening.

2.2. Dual-coding theory

Since ubiquitous learning environments require the involvement of technology, it is important to understand how multimedia supports language learning. In computer-assisted learning, the dual-coding theory, proposed by Paivio (1986), is employed to explain how multimedia helps one to learn (Iding, 2000; Mayer, 2002). Paivio (1986) asserted that information processing of human beings includes two separate but interconnected semantic systems, which are verbal-based and nonverbal-based (Zhang, Guo, Ding, & Wang, 2006). The verbal system is related to verbal codes including both visual and auditory signals, whereas the nonverbal system processes all stimuli other than verbal stimuli, consisting of figures, surrounding sounds (e.g. ring) and physical expressions, etc.

In connection with the verbal system, an individual must understand a passage word by word with a proper sequence when receiving verbal stimuli. Generally speaking, text and spoken messages are the main stimuli that are helpful to language learning (Grgurović & Hegelheimer, 2007). Text messages are helpful to language learning because (a) they can be stored and remain longer in long-term memory, when comparing with spoken messages; and (b) they can be processed by computers, such as editing and search (Bagui, 1998). On the other hand, spoken messages are good for language learning in three ways: (a) messages are expressed in an authentic way, which can be understood easily by learners who do not perform well in reading comprehension; (b) learners will not be distracted when figures and tables are shown up simultaneously; and (c) messages are best in the delivery of temporary information (Bagui, 1998). Since the verbal system is more beneficial to language learning in various ways, text and spoken messages were integrated into the learning activity as different material presentation modes, including single channel (auditory only) and dual channel (auditory and visual), in the present study.

2.3. Cognitive theory of multimedia learning and cognitive load

Multimedia, such as sound, text, figure, flash and video, can be integrated into learning. In other words, course materials can be presented to learners by various ways, and learners' performance can be facilitated by the integration of auditory and visual stimuli. Mayer (2001) suggested cognitive theory of multimedia learning based on the dual-coding theory proposed by Paivio (1986) for explaining how learners learn through auditory and visual input but is affected by cognitive load. There are three hypotheses proposed by the cognitive theory of multimedia learning, including a) dual channel, such as information coming from eyes and ears, suggesting that one can simultaneously process visual and auditory information; b) limited capacity, indicating that there is a limited capacity for one to process information through each channel; and c) active processing, meaning that during information processing, one will select the most relevant information as input and integrate the selected information with prior knowledge and mental model. Overall, learners can learn simultaneously from both auditory and visual materials, but can also be negatively affected by excessive information and limited capacity. In other words, dual channel can be helpful to learners in learning, but limited capacity or too much useless information can interrupt learners' learning (Mayer, 2001; Mayer & Moreno, 2003).

There are three types of cognitive load: intrinsic, extraneous and germane. According to Paas and Kester (2006), intrinsic load is an interaction between the nature of the material being learned and the expertise of the learners, which cannot be directly influenced by instructional manipulations; extraneous load is related to the presentation mode of the material or instructional design, and germane load
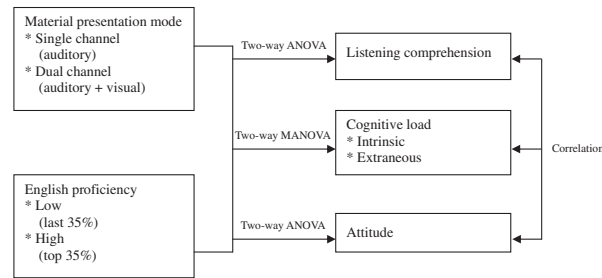
Fig. 1. Research framework.

comprises all the necessary processes of schema acquisition and automation. In general, the intrinsic load of a task depends on one's proficiency toward the subject (van Merrienboer, Kester, & Pass, 2006). In other words, the higher the proficiency, the lower the intrinsic load. On the other hand, extraneous load and germane load are similar, but they go reversely. Extraneous load happens when a learner engages in a cognitive processing that does not support the learning objective, such as poor layout, whereas germane load occurs when a learner engages in a deep cognitive processing that mentally organizes the material and relates it to prior knowledge, meaning that a learner's motivation and prior knowledge are enhanced and connected with prompts and supports in the lesson (DeLeeuw & Mayer, 2008). Since the present study aimed to understand negative effects of cognitive load from material presentation mode and the expertise of learners, only intrinsic load and extraneous load were examined in the present study.

2.4. Caption and relevant studies

Besides spoken messages, text messages were also applied in the present study as visual input to enhance learners' listening comprehension because verbal system and dual channel are helpful to language learning, as proposed by the dual-coding theory and the cognitive theory of multimedia learning. Captioning refers to the use of on-screen text in conjunction with the same language audio (Taylor, 2005). Captions help learners in language learning, especially in listening comprehension, because text, as visual input, is beneficial to learners in remembering and understanding (Bird & Williams, 2002; Huang & Eskey, 2000; Markham, 2001). Rost (2002) pointed out that captions allow learners to process language in longer time and enhance their listening comprehension. Captions enhance learners' listening comprehension by helping them visualize what they hear (Danan, 2004). A study result revealed that regardless of English proficiency, captions were important to learners in listening comprehension because learners learning with captions outperformed learners learning without captions (Markham, 1989). Froehlich (1988) found that learners majoring in German held a positive attitude toward captions and thought that captions enhanced their listen comprehension. Guillory's study (1998) about the effect of captions on listening comprehension showed that learners receiving full captions had better listening comprehension than learners receiving partial captions who outperformed learners receiving no caption, which indicated that captions have a positive impact on listening comprehension.

Although captions facilitate listening comprehension by the connection of visual and auditory input, learners can be dependent too much on them or negatively affected by them while listening to English (Vandergrift, 2007), meaning that learners receive information passively, which leads to the so-called surface learning and lowers learners' performance in listening comprehension (Diao, Chandler, & Sweller, 2007). Some researchers (Taylor, 2005; Winke et al., 2010) found that when captions were used, high proficiency learners performed better than low proficiency learners on listening comprehension. Taylor (2005) examined the use of captioned video (with Spanish captioning vs. without Spanish captioning) with beginners of Spanish and found that captions distracted low proficiency learners from listening. Moreover, Yoshino and Kano (2000) examined the use of timing on captioning with Japanese EFL students and found that cognitive load happened when captions and speech sounds appeared simultaneously because participants had limited capacity to process information from two channels (visual and auditory) at the same time. On the other hand, according to the studies done by Taylor (2005) and Winke et al. (2010), dual channel presentation (text and spoken messages) resulted in better recognition memory, implying that the

Table 1
Learning stage.

| Learning stage	Description
Pretest (First week)	1. A test on the basic knowledge about observed animals in the learning activity.
	2. Listening test from GEPT.
Training (Second week)	1. Lectured by the instructor.
	2. Introduction of ubiquitous learning, PDA and GPS.
	3. Key words included in the material were provided.
Intervention and Posttest (Third week)	1. Held in the zoo.
	2. Two learning groups: single and dual channel mode.
	3. Students learned with a PDA that was connected with GPS.
	4. Exploration of animals, including the map of Africa area in the zoo and their current location, was displayed on the screen.
	5. The system led students to target animal areas by GPS.
	6. When students arrived in the target area, the system would display its material automatically by GPS and students were required to click the play button for an audio guide to be played.
	7. After listening to the audio guide, the student must click the next page to take the listening test followed by a cognitive load rating scale.
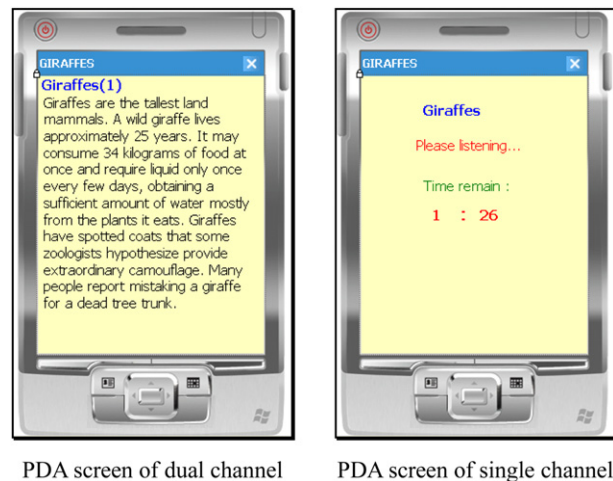
Fig. 2. Teaching material for the ubiquitous learning activity.

more input, the better, leading to increased depth of processing because learners process different input modes differently, and these input modes reinforce one another.

In sum, since the aforementioned study results regarding the effect of captions on listening comprehension among learners with different English proficiencies remain inconclusive and the most studies were done in traditional classrooms, the researchers in the present study aimed to investigate whether captions that were added to material presentation mode as dual channel had positive impacts on high and low English proficiency learners' listening comprehension, cognitive load and learning attitude in a ubiquitous learning environment.

3. Research method

A quasi-experimental design, as shown in Fig. 1, was conducted to examine the effects of material presentation mode (single channel vs. dual channel) and English proficiency (low vs. high) on university students' listening comprehension, cognitive load and learning attitude. The complete learning stage for the present study is shown in Table 1. The researcher in the present study was also the instructor of the learning activity. The instructor provided the instruction for the pretest and lectured on the introduction of ubiquitous learning, PDA and GPS. During the ubiquitous learning, the instructor acted as a facilitator to enhance students' learning by giving them instructions and helping them to handle technical problems. A technology device, PDA, was employed as a means to enrich English listening experiences for the learners in the ubiquitous learning activity. The PDA utilized in the present study is suitable for students who possess only basic computer skills.

Participants were 162 students majoring in applied foreign language in a technology university in Taiwan. All the participants possessed prior knowledge and skills on computer and had six years of formal English instruction in middle high and high school. An orientation for the use of PDA and an introduction of ubiquitous learning were provided to the participants. The participants' prior knowledge toward target animals was examined by a multi-choice test with 20 items, which was based on the information on the Encyclopedia Britannica Online, to ensure that they all possessed the basic knowledge on observed animals in the learning activity. The participants' English proficiency was determined by the General English Proficiency Test (GEPT). The GEPT is a newly developed test of English phased in by the Language Training and Testing Center in Taiwan since 2000 (Shih, 2008). There are three levels in the GEPT, including beginning, intermediate and advanced. The participants were classified into two groups based on their GEPT score at the intermediate level. The top 35% (59 students) of the students were assigned to the high English proficiency group, whereas the last 35% (58 students) of the students were assigned to the low English proficiency group. The students who ranked in the middle 30% of all the students were not included in the present study since the purpose of the present study was to examine differences between high and low English proficiency learners. The participants in each group were then assigned randomly into two different material presentation mode groups, one was single channel (spoken messages only) and the other was dual channel (text and spoken messages).

The ubiquitous learning activity in the present study was animal observation held in the Africa area of the Taipei Zoo. Students in both groups learned with a PDA and an audio guide. However, students in the single channel group learned through spoken messages only, whereas students in the dual channel group learned by text and spoken messages. Exploration of animals, including the map of Africa area in the zoo and students' current location, was displayed on the screen. The system led students to target animal areas by GPS. When students arrived in the target area, the system would display its material automatically by GPS and students were required to click the play button for an audio guide to be played. When the audio guide was playing, the PDA screen in the dual channel group

Table 2
Group means, standard deviations and numbers of English listening comprehension.

Independent variables		Mean	Standard deviation	N
Presentation mode	Single	8.50	2.651	58
	Dual	10.66	2.361	59
English proficiency	Low	8.64	2.647	58
	High	10.53	2.480	59
Total	Total	9.59	2.723	117

Table 3
Two-way ANOVA summary on English listening comprehension.

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Eta. Squared
Presentation mode	126.817	1	126.817	22.773[a]	0.000	0.168
English proficiency	94.431	1	94.431	16.957[a]	0.000	0.130
Presentation mode * English proficiency	0.000	1	0.000	0.000	0.994	0.000
Error	440.477	113	3.898			

[a] $p < 0.05$.

showed captions simultaneously, and the PDA screen in the single channel group only displayed a remaining time of spoken messages, as shown in Fig. 2. The purpose of showing captions on the PDA screen was to enhance students' listening comprehension by visualizing what they heard. During the time elapse, students must listen carefully to the spoken message and were not allowed to discuss with their classmates, take notes or replay the message. After listening to the audio guide, the student must click the next page to take the listening test.

After the experimental learning activity, participants were required to take a listening test with regard to animals they had observed and about which they learned. The test was developed by the research team of the present study. There were four passages about animals from Africa area in the Taipei Zoo in the test. Each animal was described by a passage. The passages were adapted from the website of National Geographic and San Diego Zoo. The spoken time for each passage, with length from 180 to 220 words, was about 3 min. There were 20 multiple-choice questions in the test. Each passage contained five multiple-choice questions for examining participants' listening comprehension. The total possible score was 20. The content of the test was reviewed by professors with related background and native English speakers. The test possessed a good overall item discrimination (0.33), item difficulty (0.52) and internal consistency (0.80).

A rating scale, called the Subjective Cognitive Load Rating developed by Paas and van Merriënboer (1994), was given for each passage for measuring participants' level of intrinsic and extraneous load toward each passage. Participants were required to rate themselves after answering the five multiple-choice questions for a passage. Participants were asked to rate themselves on a 7-point Likert-type scale with response options from 1 (extremely easy) to 7 (extremely difficult). The higher the score was, the higher the estimated cognitive load was. The reliability coefficient of the measures of cognitive load was 0.912, as measured by Cronbach's α.

Finally, a questionnaire, with a total of seven questions, was conducted to collect participants' feeling and attitude toward the ubiquitous learning, including interest, usefulness and convenience, etc. The questionnaire was developed by the research team of the present study. Participants were asked to rate themselves on a 5-point Likert-type with response options from 1 (strongly disagree) to 5 (strongly agree). The reliability coefficient of the measures of learning attitude was 0.974, as measured by Cronbach's α.

4. Results

In the present study, the collected data were first examined by descriptive statistics to explore the group means, standard deviations and numbers. Then, two-way multivariate analysis of variance (MANOVA) and two-way analysis of variance (ANOVA) were conducted to examine the effects of material presentation mode and English proficiency on English listening comprehension, cognitive load and learning attitude. The analyses are described as follows.

4.1. Analysis of the effect on English listening comprehension

To explore the effects of material presentation mode and English proficiency on participants' English listening comprehension, the group means, standard deviations and numbers of English listening comprehension were first analyzed by descriptive statistics, as shown in Table

Table 4
Group means, standard deviations and numbers of cognitive load.

Aspects	Independent variables		Mean	Standard Deviation	N
	Presentation mode	English Proficiency			
Intrinsic load	Single	Low	4.95	0.857	30
		High	4.27	0.779	28
		Total	4.62	0.883	58
	Dual	Low	4.69	0.644	28
		High	4.43	0.734	31
		Total	4.55	0.699	59
	Total	Low	4.82	0.767	58
		High	4.35	0.753	59
		Total	4.59	0.793	117
Extraneous load	Single	Low	4.99	0.816	30
		High	4.21	0.670	28
		Total	4.61	0.842	58
	Dual	Low	4.61	0.546	28
		High	4.37	0.871	31
		Total	4.48	0.738	59
	Total	Low	4.81	0.719	58
		High	4.29	0.780	59
		Total	4.55	0.791	117

Table 5
Two-way MANOVA summary on cognitive load.

Pillai's Trace	Source	Aspects	Type III Sum of Squares	df	Mean Square	F	Sig.	Eta. Squared
0.012	Presentation mode	Intrinsic	0.077	1	0.077	0.134	0.715	0.001
		Extraneous	0.350	1	0.350	0.635	0.427	0.006
0.109*	English proficiency	Intrinsic	6.479	1	6.479	11.261[a]	0.001	0.091
		Extraneous	7.630	1	7.630	13.855[a]	0.000	0.109
0.038	Presentation mode *	Intrinsic	1.300	1	1.300	2.259	0.136	0.020
	English proficiency	Extraneous	2.209	1	2.209	4.011[a]	0.048	0.034
	Error	Intrinsic	65.018	113	0.575			
		Extraneous	62.230	113	0.551			

[a] $p < 0.05$.

2. The average mean score equaled to 9.59 out of a total score of 20 on the English listening comprehension. For material presentation mode, the mean scores on English listening comprehension for learners receiving dual channel were higher than learners receiving single channel. On the other hand, for English proficiency, the mean scores on English listening comprehension for high English proficiency learners were higher than low English proficiency learners.

Two-way ANOVA was conducted to examine the effects of material presentation mode and English proficiency on participants' English listening comprehension. The significance level was set to 0.05 for the analysis. Levene's test of equality of covariance was insignificant ($F = 0.549$, $p = .650$) and suggested that the variances across groups were equal. Hence, the homogeneity assumption was sustained.

The summary of two-way ANOVA on participants' English listening comprehension is shown in Table 3. The interactions of material presentation mode and English proficiency for English listening comprehension were insignificant. The main effect of material presentation mode for English listening comprehension was significant ($F_{(1, 113)} = 22.773$, $p < .05$, $\eta^2 = 0.168$), meaning that learners receiving dual channel significantly outperformed learners receiving single channel. The main effect of English proficiency for English listening comprehension was also significant ($F_{(1, 113)} = 16.957$, $p < .05$, $\eta^2 = 0.130$), implying that high English proficiency learners obtained significantly higher scores than low English proficiency learners.

4.2. Analysis of the effect on cognitive load

To explore the effects of material presentation mode and English proficiency on participants' cognitive load, the group means, standard deviations and numbers of cognitive load were first analyzed by descriptive statistics, as shown in Table 4. The average mean score equaled to 4.59 out of a total score of 5 in the aspect of intrinsic load and 4.55 in extraneous load. For material presentation mode, the mean scores on intrinsic and extraneous load for learners receiving single channel were higher than learners receiving dual channel. On the other hand, for English proficiency, the mean scores on intrinsic and extraneous load for low English proficiency learners were higher than high English proficiency learners.

Two-way MANOVA was conducted to examine the effects of material presentation mode and English proficiency on participants' cognitive load. The significance level was set to 0.05 for the analysis. Box's test of equality of covariance matrices was significant ($F = 21.597$, $p < .05$). However, according to Tabachnick and Fidell (2006), a significant result of Box's test is not fatal since groups are of about equal sample size, meaning that two-way MANOVA can still be performed and Pillai's V should be observed instead of Wilks' Λ when performing Multivariate test.

The summary of two-way MANOVA on participants' cognitive load is shown in Table 5. The interactions of material presentation mode and English proficiency for the aspect of extraneous load were significant ($F_{(1, 113)} = 4.011$, $p < .05$, $\eta^2 = 0.034$). The main effect of material presentation mode was insignificant. The main effect of English proficiency was significant for all the aspects (intrinsic load: $F_{(1, 113)} = 11.261$, $p < .05$, $\eta^2 = 0.091$; extraneous load: $F_{(1, 113)} = 13.855$, $p < .05$, $\eta^2 = 0.109$), implying that low English proficiency learners obtained significantly higher scores on intrinsic and extraneous load than high English proficiency learners.

In order to further understand the interactions of material presentation mode and English proficiency on the aspect of extraneous load, the simple main effects were analyzed, as shown in Table 6 and Fig. 3. The analysis showed that English proficiency had a significant effect on the aspect of extraneous load among learners in the single channel group ($F_{(1,56)} = 15.948$, $p < .05$, $\eta^2 = 0.222$). Low English proficiency learners had significantly higher score (4.99) than high English proficiency learners (4.21), as shown in Table 3, meaning that low English proficiency learners had higher extraneous load than learners high English proficiency. On the other hand, material presentation mode had a significant effect on the aspect of extraneous load among low English proficiency learners ($F_{(1,56)} = 4.382$, $p < .05$, $\eta^2 = 0.073$). Learners learning with single channel had significantly higher score (4.99) than learners learning with dual channel (4.61), as shown in Table 3, implying that learners learning with single channel had higher extraneous load than learners learning with dual channel.

Table 6
Summary for simple main effects on the aspect of extraneous load.

Group	Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Eta. Squared
Single channel	English proficiency	8.954	1	8.954	15.948	0.000	0.222
	Error	31.442	56	0.561			
Dual channel	English proficiency	0.821	1	0.821	1.519	0.223	0.026
	Error	30.787	57	0.540			
Low level	Presentation mode	2.141	1	2.141	4.382	0.041	0.073
	Error	27.364	56	0.489			
High level	Presentation mode	0.404	1	0.404	0.660	0.420	0.011
	Error	34.866	57	0.612			

Estimated Marginal Means of Extraneous Load
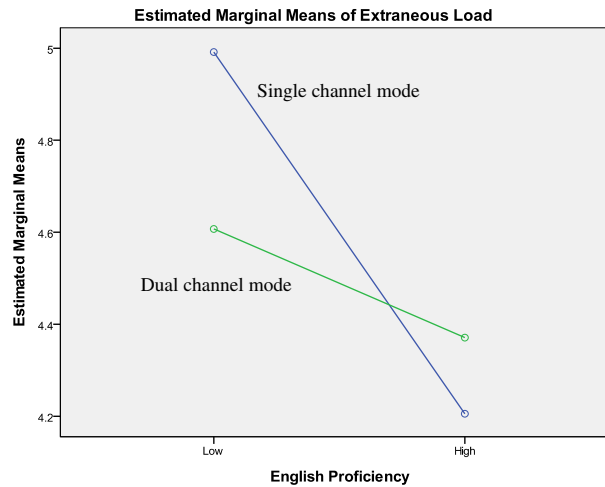

Fig. 3. Interaction of material presentation mode and English proficiency on extraneous load.

4.3. Analysis of the effect on learning attitude

To examine the effects of material presentation mode and English proficiency on participants' attitude toward the ubiquitous learning environment, the group means, standard deviations and numbers of learning attitude were first analyzed by descriptive statistics, as shown in Table 7. The average mean score equaled to 3.75 out of a total score of 5. For material presentation mode, the mean score of the dual channel group was higher than the single channel group. For English proficiency, the mean score of low English proficiency learners was higher than high English proficiency learners.

Two-way ANOVA was conducted to examine the effects of material presentation mode and English proficiency on participants' attitude toward the ubiquitous learning environment. The significance level was set to 0.05 for the analysis. Levene's test of equality of covariance was significant ($F = 4.778$, $p < .05$), which showed that variance across the groups was not equal. However, according to Pallant (2005), when Levene's test is significant, $p < .01$ is typically more acceptable to use than $p < 0.05$ to determine significance during the conduction of two-way ANOVA.

The summary of two-way ANOVA on participants' attitude regarding the ubiquitous learning environment is shown in Table 8. The interactions of material presentation mode and English proficiency were insignificant. The main effect of material presentation mode was significant ($F_{(1,\ 113)} = 6.976$, $p < .01$, $\eta^2 = 0.058$), indicating that learners receiving dual channel had a significantly positive attitude than learners receiving single channel. The main effect of English proficiency was insignificant.

5. Discussions and conclusions

According to the study results, material presentation mode and English proficiency had impacts on English listening comprehension in the ubiquitous learning environment, as the aforementioned findings done in traditional classrooms. Firstly, learners learning with dual channel significantly outperformed learners learning with single channel. This result confirmed the study done by Markham (1989) that regardless of English proficiency, captions were important to learners in listening comprehension because learners learning with captions outperformed learners learning without captions. Second, high English proficiency learners obtained significantly higher scores on listening comprehension than low English proficiency learners. This result can be explained by arguing that high English proficiency learners have more prior knowledge about English.

In the ubiquitous learning environment, material presentation mode and English proficiency also affected learners' cognitive load on English listening. Firstly, low English proficiency learners had significantly higher intrinsic and extraneous load than high English proficiency learners. High English proficiency learners have strong background in English, which helps them to connect old information to new materials and therefore lowers their intrinsic load (Sweller, van Merriënboer, & Paas, 1998). Second, for learners learning with single channel, low English proficiency learners had higher extraneous load than high English proficiency learners. Rost (2002) proposed that captions enhance learners' listening comprehension by helping learners to process language in longer time. Since single channel presentation mode does not provide learners sufficient time to process language, low English proficiency learners will have hard time to absorb what they have learned from the learning activity. Third, for low English proficiency learners, learners learning with dual channel had lower

Table 7
Group means, standard deviations and numbers of attitude toward the ubiquitous learning environment.

Independent variables		Mean	Standard Deviation	N
Presenting mode	Single	3.48	1.431	58
	Dual	4.01	0.585	59
English proficiency	Low	3.83	1.184	58
	High	3.66	1.050	59
Total	Total	3.75	1.117	117

Table 8
Two-way ANOVA summary on attitude toward the ubiquitous learning environment.

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Eta. Squared
Presentation mode	8.365	1	8.365	6.976[a]	0.009	0.058
English proficiency	1.102	1	1.102	0.919	0.340	0.008
Presentation mode * English proficiency	0.003	1	0.003	0.003	0.958	0.000
Error	135.493	113	1.199			

[a] $p < 0.05$.

extraneous load than learners learning with single channel. It seems that dual channel presentation mode helps low English proficiency learners to lower their extraneous load and enhance their listening comprehension. Text messages are helpful to language learning because they enable knowledge or information to be stored longer in long-term memory (Bagui, 1998), and dual channel presentation mode leads to an increased depth of processing that different input modes will reinforce one another (Taylor, 2005; Winke et al., 2010). In other words, dual channel presentation mode in the present study allowed low English proficiency learners to process information in sufficient time and have information to be stored longer in long-time memory; therefore they had lower extraneous load. Even though Mayer (2001) and Mayer and Moreno (2003) asserted that dual channel can interrupt learners' learning because of limited capacity, the finding in the present study suggested that dual channel can be beneficial to low English proficiency learners in lowering their extraneous load if an educator or instructional designer designs the learning activity appropriately. This finding was also contradictory to the abovementioned findings from Yoshino and Kano (2000) and Taylor (2005). This contradictory can be due to a) the background of the participants, such as they were from different countries (Yoshino and Kano's study: Japanese; the present study: Taiwanese); b) the language they learned in the learning activity (Taylor's study: Spanish; the present study; English); and c) the timing of the captioning. However, based on the findings in the present study, it is reasonable to conclude that dual channel presentation mode will not lead to high cognitive load if the dual channel presentation mode is designed with an appropriate instructional design. Shortly, determination on material presentation mode is dependent on learners' English proficiency. According to the study result, regardless of material presentation modes, low English proficiency learners possessed significantly higher intrinsic and extraneous load than high English proficiency learners. However, low English proficiency learners learning with dual channel would have their extraneous load lowered. Therefore, the finding supported that extraneous load can be influenced by instructional manipulations (Paas & Kester, 2006).

In connection with the ubiquitous learning environment in the present study, material presentation mode influenced learners' learning attitude toward the ubiquitous learning environment. Learners learning with dual channel had a significantly positive attitude toward the ubiquitous learning environment than learners learning with single channel. The study results by Chen and Chung (2008) and Liu and Chu (2010) revealed that all learners held a positive attitude toward the ubiquitous learning environment. Even though all learners in the present study also expressed a positive attitude toward the ubiquitous learning environment, learners learning with dual channel held a significantly more positive attitude than learners learning with single channel. This finding implied that dual channel presentation mode is appropriate and acceptable to be delivered by the ubiquitous learning environment.

In sum, regardless of English proficiency, captions or dual channel (text and spoken messages) can enhance learners' listening comprehension and learning attitude in the ubiquitous learning environment. Dual channel presentation mode is also beneficial to low English proficiency learners in lowering their extraneous load. Therefore, the present study result supported that learning with dual channel is helpful to English listening comprehension in the ubiquitous learning environment. Instructional designers and educators should keep the study findings in mind when designing ubiquitous learning activities for learners with different English proficiencies. The limitations for the present study included crowd and weather, which are difficult to be controlled outdoors and can negatively affect learners' learning conditions. Hence, researchers are advised to hold experiments on weekdays and indoors (for raining, hot or chilly days) for future research.

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