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Enhancing Low Achievers' EFL Learning with Interactive Digital Technologies

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Abstract: Interactive digital technology has great potentiality in providing life-like learning contexts and in-time interactions to facilitate language learning, especially for the low achievers. Contexts are essential for effective language learning. In this study, two types of digital interactive technologies, including interactive digital map (iMap) and augmented reality (AR), were employed to deliver and enhance contextualized learning experiences with gamified learning tasks for the low achievers'. The purpose of this study was to investigate the effects of type of technology-enhanced learning, including the iMap-enhanced learning and the AR-enhanced learning, on low achievers' learning performance and attitude while learning from the gamified technology-enhanced contextualized EFL learning. A preliminary experiment showed that (a) the AR-enhanced learning group outperformed the iMap-enhanced learning group on learning performance, (b) all participants' post attitudes toward the received technology-enhanced learning were significantly increased in all attitude aspects of confidence, preference, anxiety, attention, and learning strategy, and (c) both technology-enhanced learning group revealed similar positive in most attitude aspects, excepted that the AR group showed a higher degree of attention than the iMap group. It was concluded that technology-enhanced contextualized learning is effective in promoting learning attitudes and helping EFL learners achieve acceptable learning performance.

Keywords: gamification, augmented reality, language learning, English as a foreign language

1. Introduction

Contexts are essential to meaningful information processing and knowledge acquisition for language learning. The learners need to consciously attend to the language input so that the perceived information can be further processed in the working memory, but novice learners usually lack the capability in attending to the key information and result in poor comprehension efficiency. Furthermore, digital interactive technology has great potential in providing life-like learning contexts and in-time interactions to facilitate language learning. Therefore, technology-enhanced contextualization is conducive to effective language learning as it emphasizes the need of language learning in authentic and interactive situations. Thus, this study employed two types of digital interactive technologies, including interactive digital map (iMap) and augmented reality (AR), to deliver and enhance contextualized learning experiences with gamified learning tasks for the learners and expected that the low achievers can benefit from the context-rich language learning activities and bring about effective meaningful learning.

2. Related work

Learning English as a Second or Foreign language (ESL or EFL) is a global imperative as English plays an essential role in the international society (Smith et al., 2013). With the development of innovative technologies, diverse approaches to technology-enhanced language learning have emerged in recent years, providing learners with personalized, contextualized, and socialized learning experiences. Among various technologies, augmented reality (AR), virtual reality (VR), and context-aware ubiquitous learning systems have been frequently noted in the literature as facilitative for language learning, one common feature of which is that they are effective in contextualizing the learning content.

The use of AR has been increasingly popular in educational settings (Azuma et al., 2001). The literature indicates various advantages of AR, among which, the most significant one is its ability to create immersive hybrid learning environments where learning situations are contextualized through combining digital and physical objects (Akçayır & Akçayır, 2017; Dunleavy, Dede, & Mitchell, 2009). This contextualization is realized by visualizing concepts and events through displaying virtual elements over real objects (Wu, Lee, Chang, & Liang, 2013). It enables students to immerse themselves in the learning process, raises the level of engagement, and enhances educational outcomes.

Similarly, context-aware ubiquitous learning delivered by hand-held devices and smartphones has been widely acknowledged as being conducive to effective learning. With wireless communication and GPS facilities, context-aware ubiquitous learning provides learners with on-site interactions with physical objects and digital multimedia, contextualizes learning content in concrete and appropriate situations, and emphasizes the need of language learning in authentic and interactive situations. This new approach extends the applications of location-based learning and situated learning, enabling learners to interact with real-world learning targets without constraints of time or place in real situations (Ogata & Yano, 2004). Thus, it has great potentiality in promoting EFL learners' motivation and learning effectiveness.

The nature of how context-aware ubiquitous learning and AR-enhanced learning promote learning is to some extent similar in facilitating learners' sense of contextualization. They both contextualize learning contents, integrate virtual and real-world learning environments, and support real-time interactions. Despite a large number of studies on AR-enhanced learning and context-aware ubiquitous learning respectively, little research has been conducted to compare these two, and thereby the present study aimed to examine the similarity and difference between the AR-enhanced learning and the context-aware ubiquitous learning. Furthermore, as learners' attitudes towards technology-enhanced contextualized learning may vary according to the types of innovative technologies, and there has never been any attempt that compared the use of AR and interactive digital map in contextualized language learning, although these two have been investigated by several studies before, it is necessary to investigate and compare the effects of AR and interactive digital map in promoting contextualized language learning.

3. Implementations

3.1 Research design

An experimental design was implemented to investigate the effects of type of technology-enhanced learning on low English achievers of junior high school students' learning performance and attitude while learning from the technology-enhanced contextualized learning. Two types of technology-enhanced learning – the interactive map (iMap) learning and the augmented-reality (AR) learning – were implemented in the study. The participants, the experiment, data collection, and the learning activities are introduced as follows.

Sixty-five junior high students whose English achievement was under the medium score in Comprehensive Assessment Program for Junior High School Students in Taiwan participated in the experimental activities voluntarily. All participants had taken 4-class-per-week EFL courses since the seventh grade and were expected to acquire the basic grammar and the most frequently used 2000 English words through three years of study. The participants were invited to participate in the experimental technology-enhanced learning activities as a comprehensive practice for their EFL learning using tablet-PC individually. The experiment began with an orientation to the experiment project, followed by a 40-minute gamified contextualized learning activity, the iMap-enhanced contextualized learning and the AR-enhanced contextualized learning for the iMap group and the AR group, respectively. An achievement test and an attitude questionnaire survey were administered immediately after the treatment.

Analysis of Covariance (ANOVA) was conducted to examine participants' learning performance between groups with prior content knowledge as covariant to eliminate prior knowledge effect on learning achievement, paired *t*-tests were employed to examine participants' attitude changes after receiving the treatment, and Multivariate Analysis of Variance (MANOVA) was implemented to examine the differences in participants' attitude changes between groups. A significance Alpha level of .05 was used for the statistical analysis.

3.2 The treatment learning activity

Two types of technology-enhanced theme-based contextualized learning were implemented to serve as the treatments, including the iMap-enhanced learning and the AR-enhanced learning, to enhance participants' sense of contextualization of the story theme. The participants conducted their received learning activity using tablet-PCs individually. Two types of technology, iMap and AR, were employed to enhance the contextualization of the theme-based learning by navigating among learning units and trigging the target learning activity, respectively.

The two versions of technology-enhanced theme-based learning employed the same 3-learning-stages and gamified features, including (1) *Learning from video dialogue*, (2) *Learning from pictorial vocabulary*, and (3) *Practicing what you learned*. At *Stage 1*, participants conducted the learning tasks given on the associated learning worksheet and learn from the theme-based video dialogues by recording specific keywords and the meanings of specific dialogues. At *Stage 2*, the tasks were focused on learning

from the given pictorial English vocabulary, phrases and sample sentences. The content knowledge included 12 target words and the application of these words in purposeful conditions. Finally, at *Stage 3*, a practice activity was conducted for the learners to apply what they have learned in previous tasks to some given contexts in order to gain mastery.

Moreover, a gamified framework was employed to encourage the participants to engage in the learning tasks by giving them specific numbers of awarding stars according to the levels of their task performance at each learning stage. Participants' final cumulated performance was presented along with the illustrations of their received stars.

As shown on the left in *Fig. 1*, the iMap-enhanced theme-based learning utilizes the navigation function and the GPS positioning of a digital map and allows learners to explore and learn the geographic-arranged theme-based content through intuitive navigation or real-time GPS positioning. Furthermore, as shown on the right in *Fig. 1*, the AR-enhanced theme-based learning utilizes the AR recognition function and allows learners to explore and learn the geographic-arranged theme-based content through AR interactions.

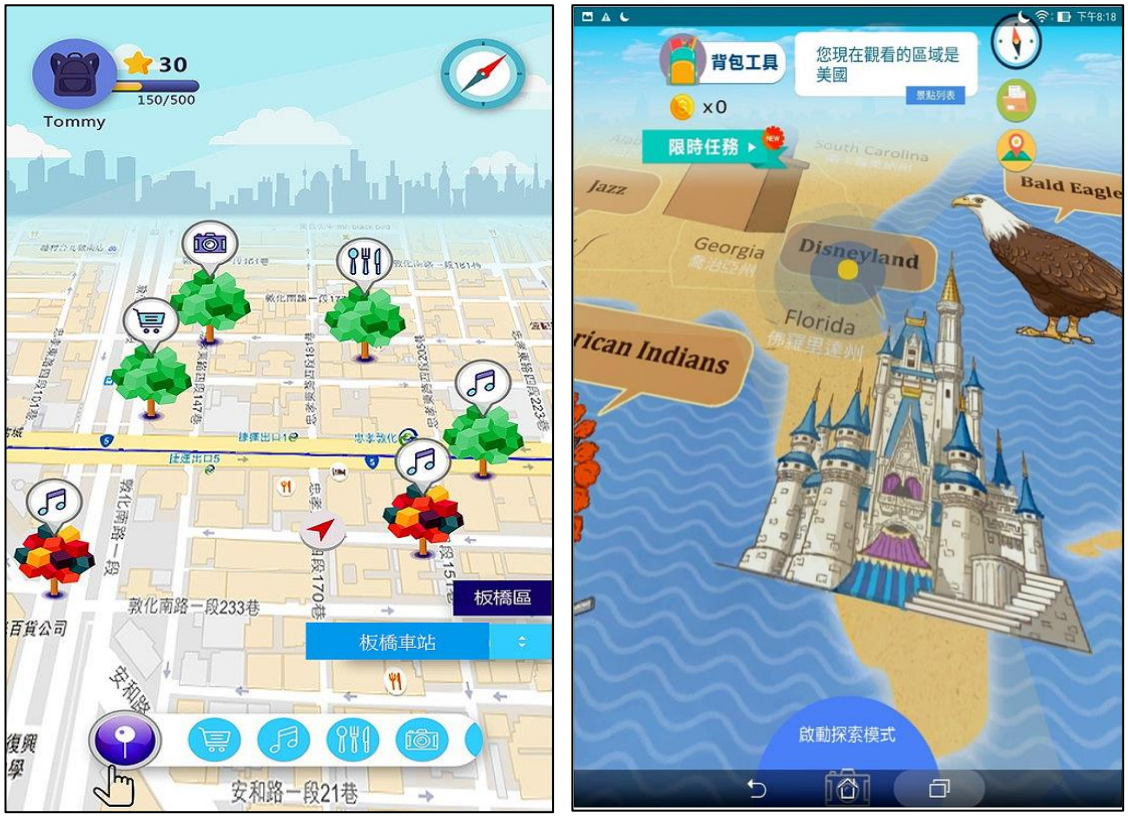

Figure 1. The interactive digital map (iMap, on the left) and the interactive AR (on the right) assist learners to navigate and learn the theme-based content.

An English content knowledge test was administered prior to and immediately after the treatment to evaluate participants' previous acquired prior knowledge and learning achievement from the treatment, respectively. Similarly, a 5-aspect 25-item attitude questionnaire was conducted prior to and after the treatment to survey participants' learning attitudes toward previous EFL learning and their received versions of technology-enhanced contextualized EFL learning, respectively.

4. Results

4.1 Analysis on learning performance

The group means of participants' learning performance in English content knowledge are shown in Table 1. The overall mean scores reached acceptable levels of 49.49% and 56.51% of correct-answer-rate for the iMap group and the AR group, respectively. The AR group had a higher mean score and lower deviation than the iMap group. Analysis of Covariance (ANCOVA) was conducted with prior content knowledge as covariant to examine whether the difference of participants' learning performance between groups is significant. As shown in Table 2, the ANCOVA summary indicates that prior content knowledge was significant on learning achievement. That is to say, employing prior content knowledge as covariant in the analysis can eliminate the impact of prior content knowledge on participants' learning achievement. Moreover, the type of technology-enhanced learning is also significant ($F_{(1, 62)}$=13.07, p<.01), indicating that the AR group outperformed the iMap group while learning from the technology-enhanced learning. In other words, the embodied AR-enhanced learning seemed to bring about better learning achievement than the virtual navigation of the digital map did.

Table 1
Group Means and Standard Deviations of Learning Performance

GRP	Mean	S.D.	*n*
iMap	49.49	8.98	32
AR	56.51	7.12	33
Total	53.25	8.71	56

Table 2
ANCOVA Summary on Learning Performance with Prior Content Knowledge as Covariant

Source	Type III Sum of Squares	*df*	Mean Square	*F*	Sig.	Partial Eta Squared
Prior Knowledge	279.33	1	279.33	4.62	.04	.08
Group	789.62	1	789.62	13.07	.00	.20
Error	3202.57	62	60.43			

4.2 Analysis of learning attitude

As shown in Table 3, the group means and standard deviations of pre-attitude and post-attitude indicate that participants seemed to possess higher confidence, preference, attention, and learning strategy, but lower anxiety. The summary of paired *t*-tests, as shown in Table 4, indicates that participants' attitude changes before and after the treatment are significant in all attitude aspects. That is to say, the implemented technology-enhanced learning brought about a higher degree of confidence, preference, attention, and learning strategy, but lower anxiety for the participants. Whether different types of technology-enhanced learning has a similar or different impact on attitude is further analyzed as follows.

As shown in Table5, the group means and standard deviations of attitude changes the iMap group and the AR group suggest that the AR group seemed to obtain higher attitude changes in all aspects of

confidence, preference, anxiety, attention, and learning strategy. Multivariate Analysis of Variance (MANOVA) was implemented to examine the differences in participants' attitude changes between the experimental groups. The results suggest that both the AR group and the iMap group obtained a similar degree of attitude increases in confidence, preference, attention, and learning strategy, but the AR group possessed a higher attention increase than the iMap learners. The results suggest that the embodied AR-enhanced learning seemed to draw more attention of the learners and engage them in the learning activity than the virtual navigation on the digital map of the iMap learners did. It is reasonable to infer that the embodied AR interactions can engage the learners in the information processing efficiently and, therefore, result in meaningful and effective learning.

Table 3
Group Means and Standard Deviations of Pre-Attitude and Post-Attitude

	Attitude Aspect	Mean	Std. Deviation	*n*
Pair 1	Pre-Confidence	2.59	1.50	65
	Post-Confidence	3.04	.91	65
Pair 2	Pre-Preference	2.52	1.48	65
	Post-Preference	3.02	.93	65
Pair 3	Pre-Anxiety	3.18	1.34	65
	Post-Anxiety	2.54	.60	65
Pair 4	Pre-Attention	2.45	1.29	65
	Post-Attention	3.05	.57	65
Pair 5	Pre-Strategy	2.61	1.45	65
	Post-Strategy	3.25	.80	65

Table 4
Summary of T-Tests on Attitude Differences

	Attitude Aspect	Mean	Std. Deviation	*t*	*df*	Sig. (2-tailed)
Pair 1	Post-Confidence – Pre-Confidence	.46	1.27	2.04	64	.05
Pair 2	Post-Preference – Pre-Preference	.50	1.22	2.32	64	.03
Pair 3	Post-Anxiety – Pre-Anxiety	-.64	1.15	-3.15	64	.00
Pair 4	Post-Attention – Pre-Attention	.60	1.11	3.05	64	.01
Pair 5	Post-Strategy – Pre-Strategy	.65	1.25	2.93	64	.01

Table 5
Group Means and Standard Deviations of Attitude Difference for the iMap and AR Groups

Attitude Difference	GRP	Mean	Std. Deviation	*n*
Confidence	iMap	.21	1.27	32
	AR	.46	1.07	33
	Total	.33	1.17	65
Preference	iMap	.24	1.22	32
	AR	.50	.97	33
	Total	.37	1.10	65
Anxiety	iMap	.32	1.15	32
	AR	.64	1.04	33
	Total	.47	1.10	65
Attention	iMap	.06	1.11	32
	AR	.60	1.02	33
	Total	.33	1.09	65

Strategy	iMap	.22	1.25	32
	AR	.65	1.16	33
	Total	.43	1.22	65

Table 6
MANOVA Summary of Type of Technology on Attitude Differences

Source	Dependent Variable	Type III Sum of Squares	*df*	Mean Square	*F*	Sig.	Partial Eta Squared
GRP	Confidence	1.02	1	1.02	.74	.39	.01
	Preference	1.08	1	1.08	.89	.35	.01
	Anxiety	1.69	1	1.69	1.41	.24	.02
	Attention	4.75	1	4.75	4.17	.05	.06
	Strategy	2.99	1	2.99	2.05	.16	.03
Error	Confidence	86.78	63	1.38			
	Preference	76.51	63	1.21			
	Anxiety	75.40	63	1.20			
	Attention	71.86	63	1.14			
	Strategy	91.95	63	1.46			

5. Conclusions

This study employed a gamified framework to implement two types of technology-enhanced contextualized learning to promote learners to learn theme-based EFL learning content by means of 3-stage of learning activities of *Learning from video dialogues*, *Learning from pictorial vocabulary, and Practicing what you learned*. The employed gamified framework aimed to encourage the participants to engage in the learning tasks by giving them awarding stars in accordance with their task performance. The AR-enhanced learning and the iMap-enhanced learning were employed to provide life-like theme-based contexts and in-time embodied and virtual interactions to facilitate EFL learning. The preliminary analysis confirmed the research hypotheses as follows. Firstly, both types of technology-enhanced learning brought about acceptable learning effectiveness, and the embodied AR interactions can engage the learners in the information processing efficiently and, therefore, result in meaningful and effective learning. Secondly, all participants showed positive attitude changes toward technology-enhanced learning in confidence, preference, attention, and learning strategy, but lower anxiety, and it suggested that technology-enhanced contextualized learning is effective in promoting learning attitudes and helping EFL learners achieve acceptable learning performance. Thirdly, the embodied AR-enhanced learning draw more attention of the learners and engaged them in the theme-based learning contexts than the digital map virtual navigation of the iMap did, and therefore, it resulted in meaningful and effective learning. Finally, future studies are suggested to examine the superiority of AR interactions in facilitating learners' sense of contextualization and engagement in learning tasks in detail.

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