Journal of English language
Teaching and Learning
University of Tabriz
Volume 11, Issue 23, (Spring & Summer 2019)

Augmented Reality and Virtual Reality Scaffoldings in Improving the Abstract Genre Structure in a Collaborative Learning Environment: A CALL Study*

Hassan Soleimani**
Associate Professor, Department of TEFL and English Literature, Payame Noor University, Tehran, Iran.
Alireza Jalilifar***
Professor, Department of TEFL and English Literature, Shahid Chamran University of Ahvaz, Iran.
Afsar Roohi****
Associate Professor, Department of TEFL and English Literature, Payame Noor University, Tehran, Iran.
Mahboubeh Rahmanian (Corresponding author) *****
PhD candidate, Department of TEFL and English Literature, Payame Noor University, Tehran, Iran.

Abstract
The marriage between technology and teaching in educational milieus in recent years has been a major concern among educational researchers in general and applied linguists in particular as far as augmented reality (AR) and virtual reality (VR) are concerned. Augmented reality after virtual reality received much attention over the last decades in mobile assisted language learning context. AR mixes virtual world onto real environment, VR delve the participants in to the virtual world. To examine the effect of AR and VR on abstract writing of EFL students, 12 intermediate proficiency pairs (high and low proficiency) participated based on their scores on TOEFL and a hypothetical abstract writing task. The participants were required to write an abstract according to the sub-moves of Hyland's (2000) move analysis provided through three mobile applications including AR-, VR HeadSet virtual reality-, and paper-based scaffoldings for four weeks in a collaborative context. In evaluating the groups' abstract writing scores before and after the treatment, no significant differences were found among the three groups. However, the AR group revealed better mean average results ($M = 33$) compared to the other VR ($M = 24$) and paper-based groups ($M = 29$). Besides, the low intermediate proficiency subjects in the AR group received higher scores ($M = 40$) compared to heir higher counterpart ($M = 37$). Results imply that the integration of real and unreal worlds might be a good asset in teaching the genre of abstracts to EFL learners in general and low intermediate proficiency learners in particular.

Keywords: augmented reality scaffolding; virtual reality scaffolding; abstract genre structure; collaborative writing; mobile-assisted language learning

* Received date: 2019/01/15 Accepted date: 2019/04/24

** Email: h_soleimanis@pnu.ac.ir
***Email: a.jalilifar@scu.ac.ir
****Email: afsar.rouhi@pnu.ac.ir
*****Email: rahmanian@student.pnu.ac.ir

Introduction

The marriage between technology and learning/teaching in educational milieus in recent years has been a major concern among educational researchers in general and applied linguists in particular. Furthermore, as far as academic writing is concerned, improving genre awareness has long been the focus of many researchers and practitioners, and computer-assisted language learning (CALL) technologies, and more specifically mobile-based ones in this domain, might be a favorable platform to achieve the purpose of teaching writing proficiency. Augmented Reality (AR) as a more recent CALL technology and the basic connector of the twenty-first century (Kroeker, 2010) is believed to have a rich capacity in augmenting learning and teaching (e.g., Billinghurst & Duenser, 2012; Dede, 2009; Squire & Jan, 2007). Contrary to virtual reality (VR), which involves the participants in the virtual environment (Bower, Howe, McCredie, Robinson & Grover, 2014), AR can sharpen the primary senses of individuals to see a more productive teaching environment (Specht, Ternier, & Greller, 2011). AR appears to have a rich potential to enhance the learners' motivation (Billinghurst & Duenser, 2012; Tarng & Ou, 2012), achievement (Lee, 2012; Rasimah, Ahmad, Zaman, 2011; Tarng & Ou, 2012), and learning attitudes and perception (Jerry & Aaron, 2010). Furthermore, some studies (e.g., Ting, 2015; Wang, 2017a; Wang, 2017b) have investigated improving writing proficiency using AR as an assistance technology. However, there is a dearth of studies in using AR and VR learning resources in improving the genre awareness of the learners. From the important genres in the scientific community, this paper focusses on the generic structure of abstracts of research articles (RAs) since they are not only the 'first impression' (Swales, 1990, p.138), but also the 'gate-keeping' (Swales, 1990, p.181) to be kept along with the RAs. Therefore, following Mobile-assisted Language Learning (MALL), the major objective of this study is to examine the effect of AR-based and VR-based scaffolding on learning generic structure of abstracts of RAs by EFL learners.

Literature review

Recently, there has been wide interest in using CALL-based technologies in teaching processes. AR as a newly-developed instrument is fertilized through the development of IT and smart phones (Chen, Chen, Huang, & Hsu, 2013). AR mixes the real and virtual worlds through simultaneous interaction between constant and moving objects (Rice, 2007; Specht, Ternier, & Greller, 2011). The possibility of adopting this technology in multiple mobile applications such as Learn AR, Fetch Lunch Rush, and Zooburst have generated interest in its wide use in educational fields (Wang, 2017a). The intriguing AR has brought about many attractive and memorable opportunities for the educational parties (Azuma, 1997). Compared to the previous two dimensional texts, studies have claimed that AR mobile applications can fulfill both the affective and cognitive dimensions of the teaching and learning process (Bitter & Corral, 2014), that is enhancing the learners' motivation (Billinghurst & Duenser, 2012; Tarng & Ou, 2012) and their learning achievement (Tarng & Ou, 2012). A central issue in AR is its validity in a number of learning theories (Johnson, Smith, Levine, & Haywood, 2010; Shelton, 2002), such as Constructivist learning (Kerawalla, Luckin, Seljeflot, & Woolard, 2006); situated learning (Chen & Tsai, 2012; Rasimah et al., 2011); and game-based learning (Dunleavy, Dede, & Mitchell, 2009; Klopfer & Squire, 2008; Squire & Jan, 2007); and inquiry-based learning (Johnson et al., 2010).

Some studies on AR technology have examined how and to what extent learning skills can be improved. Bacca, Baldiris, Fabregat, and Graf (2015) and Cifuentes, Garcia, Andrés-Sebastia, Camba, and Contero (2016) investigated how AR with its combinatory foundation can develop the learning skills of the participants. Rapid changes in IT and mobile technologies have had a serious effect on applying AR in the recent years. As such, mobile AR were used in different disciplines (Chen, Chen, Huang, & Hsu, 2013; Bacca et al., 2015; Chang, Yu, Wu, & Hsu, 2016) to retain specific instructional content in the memory of the learners.

Reviewing the related literature on AR in formal education, few studies have been found on improving the writing proficiency of learners. Ting (2015) examined whether AR could develop the Chinese writing of elementary school learners through comparing picture- and AR- based techniques of teaching writing. However, no superiority was observed in the skill and content of writing between the groups under study. Wang (2017a) investigated the influence of AR-based learning material blended with paper-based supports and only paper-based writing support on Chinese writing skill of 30 twelfth-grade students. The results revealed that intermediate students benefitted more in content control, article structure, and wording. Furthermore, he found that using AR, low-achiever participants could begin their writing faster and with more outlining content at hand. Wang (2017b) compared online-based and AR-based groups in a software editing course in 103 college students. Motivation, learners' engagement, and peer interaction were demonstrated to be enhanced using AR contents. Learning involvement was also more permanent for the AR group compared to the control group. Some limitations were also reported in the study: Not enough experience with AR application, internet problems, technical requirements of mobiles, small size of the mobile screen, and overloading of the AR information.

Augmented reality and virtual reality

About 60 years ago, Ivan Sutherland used visualization and head-mounted device to create a new environment called VR (Sutherland, 1968). Computer graphics was the basis of creating new simulation. Gradually, in the 1990s, adding more sophisticated technologies, VR went to AR environments. Milgram and Kishino (1994) devised a continuum to place these two environments whose common point is the virtual element. Their virtuality continuum (Figure 1) locates the two environments of real and virtual along two extremes. At one end the real objects and at the other the computer simulations locate; in the middle points, however, mixed reality places (mixing real and virtual elements, that is embedding virtual objects on real environment (AR) or embedding real objects on virtual environment (augmented vitality). While in VR the individual cannot see the real world anymore and is completely involved within the virtual environment, in AR the individual can see the real world along with some embedded virtual objects on it. Azuma (1997) knows the interaction of real and virtual objects in real time as the distinctive features of AR compared to VR.

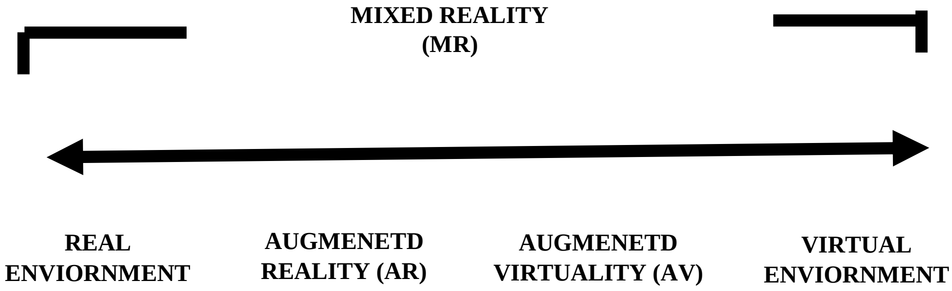

Figure 1. Milgram and Kishino's (1994) reality–virtuality continuum.

Augmented reality and virtual reality: An interactive platform

Augmented reality and VR do not take place in vacuum, and their materialization requires interactive and collaborative contexts. AR provides a good platform for peer interaction and collaboration following the concept of *zone of proximal distance* (ZPD) as stated in the constructivist models and theories. Previous studies by Matcha and Awang Rambli (2011) and Wang (2017b) found out the capacity of AR for peer interaction and collaboration. As a matter of fact, computer-supported collaborative learning (CSCL) is used in this context which uses technology to create shared understanding in a meaning-making interaction (Koschmann, 2002). The research on CSCL is based on the social constructivism since collaboration is the context in which learners interact and negotiate meaning with each other (Li, 2018). Scaffolding as a pivotal conception comes from Lev Vygotsky's sociocultural theory and the zone of proximal development (ZPD). The zone of proximal development (ZPD) is 'the distance between the actual developmental level as determined by independent problem solving and the level of potential development as determined through problem solving under adult guidance, or in collaboration with more capable peers' (Vygotsky, 1978, p. 86). Understandably, it mentions that a task beyond the competence of the learners can be done successfully through appropriate scaffolding of the capable peer or knowledgeable resource. In this case, the scaffolding instruction can 'provides scaffold or support to facilitate the learner’s development and performance' (Gong, Tan, & Chin, 2018, p. 123) in order to let the individual do the tasks independently. The present study is built upon the scaffolding of the collaborating peers through using AR-, VR-, and paper-based (real environment) learning resources in order to not only remedy the problems of the previous research in AR, but also address a significant problem of novice writers. Improving the abstract genre awareness of intermediate students through careful designations of AR and putting this aim in a more comprehensive framework of AR, VR- and paper- based scaffoldings in a collaborative context can enumerated as the significant points of this study.

Generic structure of abstracts

The abstract as the blueprint of a research article plays a key role in writing academic articles, and writers’ mastery over abstract moves appears crucial for publishing in valid journals. Hyland (2002) holds that 'the abstract is generally the readers’ first encounter with a text, and is often the point at which they decide whether to continue and give the accompanying article further attention or to ignore it' (p. 63). Abstracts are composed of different moves which are defined as 'a discoursal [sic] or rhetorical unit that performs a coherent communicative function in a written or spoken discourse' (Swales, 2004, p. 29). Each move is classified into different sub-moves or *steps*.

The pioneer in this field can be traced back to Swales (1981). He firstly introduced his four-move model of an introduction which was then changed into his three-move model of move analysis in 2004 known as CARS model. Dos Santos (1996) attempted to enrich Swale's model through presenting five moves: Establishing the niche, occupying the niche, describing the methodology, summarizing the findings, and discussing the research. Although genre analysis literature has observed different models of abstract move analysis, in the current study, we focused on the Hyland’s (2000) five-move model: Introduction, Purpose, Method, Product, and Conclusion. The sub-moves or steps of Hyland’s (2000) model of move analysis are as follows:

1. Introduction: establishes context of the paper and motivates the research.

   Step 1. Arguing for topic prominence,

   Step 2. Making topic generalizations,

   Step 3. Defining terms, objects, or processes, and

   Step 4. Identifying a gap in current knowledge

2. Purpose: indicates purpose, thesis or hypothesis, outlines the intention behind the paper.

   Step 1. Stating the purpose directly

3. Method: provides information on design, procedures, assumptions, approach, data, etc.

   Step 1. Describing the participants,

   Step 2. Describing the instruments or equipment, and

   Step 3. Describing the procedure and conditions

4. Product: states main findings or results, the argument, or what was accomplished.

   Step 1. Describing the main features or properties of the solution or product

5. Conclusion: interprets or extends results beyond the scope of the paper, draws inferences, points to applications, or wider applications.

   Step 1. Deducing conclusions from results,

   Step 2. Evaluating value of the research, and

   Step 3. Presenting recommendations

To sum up, as the literature on AR and writing proficiency reveals, no specific studies have been conducted on improving the academic writing proficiency of intermediate EFL learners adopting AR technology, so the need to delve into the issue of AR/VR environments and RAs abstract genre learning by graduate students in formal academic settings. To this end, the following questions were addressed:

1. Do AR and VR scaffoldings significantly improve academic abstract writing of intermediate EFL students within MALL environment?
2. What is the effect of AR and VR scaffoldings across different language proficiency levels on improving the abstract writing skill of the participants?
3. How do participants perceive of using AR scaffolding in MALL environments?

Method

Both quantitative and qualitative data instruments were used to examine both the learning and affective perceptions of the participants in using technological scaffoldings. In this study, three modes of presentation were compared in order to unravel how technology might improve EFL learners' writing skill. In addition, the questionnaires were used to know the learners' feedback and attitudes towards traditional and digital scaffoldings.

Participants

Twenty four participants (*M* = 26.66; *SD* = 2.76) in an advanced research summer course were selected based on their English language proficiency (460-490 for the TOEFL), writing proficiency (four to six in TOEFL writing module), and abstract writing skill from a university in Isfahan, Iran, in the academic year 2018. Applying power analysis prior to the study (G*power 3.1.9.2 software required a total sample size of 24 for the effect size of .8 and power of .9).

The participants were then classified into two high and low proficiency groups, based on their TOEFL scores, in order to have high and low intermediate proficiency subjects. Afterwards, each participant in the high intermediate group was paired with another participant in the low intermediate group. The obtained 12 pairs were then randomly assigned into two experimental (AR- and VR-based scaffolding) and one control (paper-based scaffolding) groups. In fact, four pairs of intermediate learners were assigned to each of the AR- and VR-, and paper- based scaffolding groups.

Instruments

Scoring rubrics

TOEFL PBT Proficiency Test (2004) and its writing section were administered for the purpose of participants homogeneity prior to any treatment. In addition, in line with the purpose of the study, they were also examined to understand whether they knew the generic structure of abstracts. To this end, a scoring rubric applying Hyland's (2000) model was devised which assigned five points (function, tense, and vocabulary) to each of the 12 sub-moves.

Augmented reality (AR) application

The AR multimedia used in the present study was based on *Ownar* AR mobile application (https://cafebazaar.ir/app/com.nikmodern.ownar) for *Android* and (https://itunes.apple.com/us/app/ownar/id1247386794) for Apple's *iOS* operating systems. Since the application was already designed, we went through the development, implementation, and evaluation steps. *Ownar* AR application was developed using the researchers' points of view in preparing the RA abstract scaffolding to let the AR application has its most benefits. The *Ownar portal website* let us insert different images, photo galleries, videos, voices, three-dimensional websites, store, SMS, phones, places, and social networks to a predetermined picture. The output was then printed out to let the participants scan it through their mobile cameras and do their writing task, using the embedded digital items as their scaffolding.

After preparing the AR material, a focus group was required to comment on the scaffoldings through filling a questionnaire which included five Likert scale and one open-ended question (about the content and the way of demonstration). The Likert items were about the general organization of the sessions, cognitive load of the embedded media, quality of the embedded media, sufficiency of the embedded media for introducing each sub-move, and suitability of the abstracts used for introducing the sub-moves; and the open-ended question was about the suggestions they might have for the better improvement of the treatment, for each session. We were justified to elaborate on each sub-move by introducing RA abstracts from ISI-indexed journals in the field in order to make the tasks more genuine. Furthermore, we decided that three to four linguistic chunks and vocabulary items might be enough for presenting each sub-move which could then be embedded within two sentences for their preliminary presentation.

Meeting the requirements, the output papers were printed out. The printed papers were then distributed among the subjects in order to be scanned and processed through their smart phone cameras. To test the system, a pilot study was carried out with four students in order to develop the last version of AR. Their feedback about the general structure of the scaffoldings including the content, the presentation mode, and the time required were noted. The noted suggestion about presenting more examples for each sub-move was acknowledged and applied in the system design. Finally, the AR scaffolding was developed and was ready for implementation.

As Hyland's (2000) model of move analysis contains 12 sub-moves and the study took for four weeks, four sub-moves were taught each week. About five printed handouts containing the related guidance through video or audio materials were prepared for each sub-move by which the subjects were supposed to do their assigned writing tasks. The first session was devoted to a brief introduction of the concept of abstract, move, sub-move, and models of move analysis. Each of the other three sessions were about each of the four sub-moves of the Hyland's (2000) model: The rhetorical and syntactical information along with some sample sentences and abstracts. Following each session, the subjects were asked to write their own hypothetical abstract sub-moves using the provided chunks and words. This was supposed to help writers who do not have enough academic writing experience in writing abstracts get more involved with the academic community.

Virtual reality (VR)

As the content of scaffolding and the assigned writing tasks were supposed to be the same for the three groups, the VR group was exposed to the same vocabulary items and structures. However, for the VR group the content was transformed into 3D films which could be watched through Virtual Reality Headset (P-Net VR-100 Virtual Reality Headset). Watching through the sensors of this headset, the subjects could see themselves in the virtual environment of the learning resources and the environment could change on the basis of changing their body position. The simulation and visualization of the object, environment, and space could make a real environment for the subjects by which they were supposed to carry out their assigned writing task, in collaboration.

The 360 degrees virtual environment could provide the required learning resources for conducting the task. This inspired three-dimensional sense of the environment was also examined with the same focus group of the AR scaffolding. They commented on the speed of the film and its clarity. Adopting the suggestions, a pilot study with five intermediate students was also run in order to qualify the VR learning resources. We used P-Net VR-100 Virtual Reality Headset since it was more adaptable to different mobile phones, with compatibility to 3.5 to 5.5-inch mobile and to both Android and iOS systems. Furthermore, it could create a clearer picture adjustable widescreen with no gyroscope sensor needed.

Questionnaires

With the writing measurements, an AR questionnaire used by Wang (2017a) was also administered to reveal participants' opinions and ideas towards adopting AR in teaching genre structure. The questionnaire was adapted for the AR group, specifically, to evaluate their perception on the design of AR scaffolding. It consisted of eight Likert scale items (*strongly agree, agree*, *neutral, disagree*, *strongly disagree*) by which the participants could express their opinions towards scaffolding materials and three open-ended questions. The reliability of the questionnaire was reported as $r = .77$ using Cronbach's α test.

Procedure

In order to understand how AR and VR scaffoldings could behave for intermediate learners, a series of steps were followed. The three groups of AR, VR, and paper- based scaffolding were firstly required to write two hypothetical abstracts upon a topic (as the pretest). The writings were scored based on Hyland's (2000) model of move analysis . The scoring rubric was upon five points to each move, and each move was analyzed based on the required function, tense, and vocabulary items. To examine the reliability of the scorings, the inter-rater reliability index was calculated for each abstract using two experienced research professors. Then, the participants were explained about the assigned tasks that they needed to do in the four sessions of abstract writing, using their own scaffoldings and the manner in which they were required to do the tasks _ each session took about 20 minutes. Each session, the subjects were required to write a paragraph in pair, using their assigned scaffoldings: The paper-based group had their scaffoldings in separate papers, the AR-based group had them through an AR mobile application, and the VR-based group had the same scaffoldings in 3D films to be watched through VR headsets. However, the content scaffolding of each groups was the same. The only difference among the groups was in the mode of the scaffoldings to be exposed to and the way they were presented. For VR group, after checking the technical properties of their mobiles, the explanations were provided for them.

Furthermore, in carrying out the tasks, the participants were asked to collaborate with each other in pairs in order to reach a shared understanding. Following Storch (2013), according to the principles of collaborative writing for shared responsibility, interaction, negotiation of meaning, and making joint decisions for having one writing output were also explained to the subjects.

After modeling the collaborative writing, they were asked to practice it with their partners and ask their questions. Two days after the four sessions of treatment, the participants were asked to write two hypothetical abstracts according to Hyland's (2000) model of abstract writing they learned through the scaffoldings. Two weeks later, they were again asked to write two other abstracts in order to assess their long term retention (as the delayed posttest). The writings were scored by the same two experienced professors and their inter-rater reliability was examined. Alongside the participants’ writing performance, their perceptions towards using AR technology and writing in general were also examined using the two questionnaires adapted from Wang (2017a) distributed to the three groups after the experiment.

Results

To determine the correlation between the raters, their reliability of scoring was assessed using Spearman's rank correlation coefficient (***r*** = 0.71; *p* = 0.04, ***r*** = 0.73; *p* = 0.04, and ***r*** = 0.69; *p* = 0.04). The raters were trained and two RA abstracts from the subjects were given to the raters and they were asked to score them. They showed a high reliability in terms of the scoring rubrics. However, the raters encountered the problem of move embedding while scoring. This unavoidable phenomenon (Bhatia, 1994; Dos Santos, 1996) refers to time when 'a sentence may sometimes be a realization of more than one move.' (Samraj's, 2005, p. 146). Marking these moves, the raters then consulted with each other about them to reach a consensus. No score was also given when a sub-move was not mentioned.

Research question one

The normality of the data was tested statistically to reveal the distribution of the data; K-S normality index was met for the VR group (p = .20, p < .05). The homogeneity of the data was also recognized by Levene's test of homogeneity. Due to the normality of the data and the equality of variance assumption (p = .346 p < .05), *one-way repeated measures ANOVA* was run to compare scores in three pretest, immediate posttest, and delayed posttest. The descriptive statistics are presented in Table 1. From the data, it is apparent that VR had the highest impact on the subjects in the immediate posttest (*M*= 33.50, *SD*=6.09) not the delayed posttest (*M*= 29.37, *SD*=5.78). Long-term retention, as such, cannot be regarded for this group. However, significant effect for time, Wilk's Lambda = 130, F (2 , 6) = 20.03, p<.05, multivariate partial eta squared=.87 (Table 2). The effect size of .87 denotes a very large effect size. The pairwise Comparisons (Table 3) shows where the differences locate: The difference between the immediate and delayed posttests was significant (*p*=.001, p<.05).

For the AR group, the normality and homogeneity of the data were evaluated, as well. K-S normality index (*p* = .20, p < .05) and Levene's test of homogeneity (p = .21, $p < .05$) for the AR group highlighted normal and homogeneous data distribution, which in effect, *one-way repeated measures ANOVA* was calculated. Comparing the pretest, immediate posttest, and delayed posttest , AR group showed a significant difference. The descriptive statistics again shows the priority of immediate test (M= 39.25 , SD=3.53) over delayed posttest (M=34.12, SD= 3.04) (Table 1). Table 2 shows that a significant effect for time can be regarded: Wilk's Lambda = .07, F (2 , 6) = 36.44, $p<.05$, multivariate partial eta squared=.92 (a very large effect size). However, to locate the differences, the results obtained from Table 3 unravels all differences to be significant. The emerged interesting result is somehow at odds with the VR group whose only significant result was between immediate and delayed posttests.

Table 1

Descriptive Statistics for the One-Way Repeated Measures ANOVA of VR and AR Groups

	M	**SD**	**N**	**M**	**SD**	**N**
Pretest	24.87	4.18	8	25.50	5.15	8
Immediate posttest	33.50	6.09	8	39.25	3.53	8
Delayed posttest	29.37	5.78	8	34.12	3.04	8

Table 2

Effect		Value	F	Hypothesis df	Sig.	Partial Eta Squared
factor	Pillai's Trace (AR)	.92	36.44[a]	2.00	.000	.92

	Wilks' Lambda (AR)	.07	36.44[a]	2.00	.000	.92
	Pillai's Trace (VR)	.87	20.03[a]	2.00	.002	.87
	Wilks' Lambda (VR)	.13	20.03[a]	2.00	.002	.87

Multivariate Tests for the One-Way Repeated Measures ANOVA of VR and AR Groups

Table 3

Pairwise comparisons for the One-Way Repeated Measures ANOVA of VR and AR groups

(I) factor1	(J) factor1	MD (I-J) (VR)	SE (VR)	Sig.[a] (VR)	MD (I-J) (AR)	SE (AR)	Sig.[a](AR)
1	2	-8.62	3.26	.100	-13.75*	1.56	.000
	3	-4.50	2.99	.530	-8.62*	1.29	.001
2	1	8.62	3.26	.100	13.75*	1.56	.000
	3	4.12*	.61	.001	5.12*	.69	.000
3	1	4.50	2.99	.530	8.62*	1.29	.001
	2	-4.12*	.61	.001	-5.12*	.69	.000

To demonstrate if the technological or traditional scaffoldings might be effective in enhancing the subjects' RA abstract writing skill, the writing performance of the three groups were investigated. The K-S normality index ($p = .17$, $p < .05$) and the homogeneity of variances ($p = .09$, $p < .05$) presented normal distribution of data, leading to one-way between-groups ANOVA. Table 4 presents the descriptive statistics for the three AR, VR, and traditional groups. The AR group (M= 39.25, SD= 3.53) illustrates the best results compared to the VR (M=33.50, SD=6.09) and paper-based group (M= 35.00, SD=8.33). However, the one-way ANOVA (Table 5) demonstrated no statistically significant difference at the $p < .05$ level in the writing scores for the three groups: $F(2, 21) = 1.793$, $p=.191$.The most striking result to emerge from the data is that no difference could be observed between the three modes of scaffoldings.

Table 4

Descriptive Statistics for the Three AR, VR, and Paper-Based Groups

	N	M	SD	SE
VR	8	33.50	6.09	2.15
AR	8	39.25	3.53	1.25
paper	8	35.00	8.33	2.9
Total	24	35.91	6.51	1.32

Table 5

One-Way ANOVA Test for the Three AR, VR, and Paper-Based Groups

	Sum of Squares	df	MS	F	Sig.
Between Groups	142.33	2	71.16	1.793	.191
Within Groups	833.50	21	39.69		
Total	975.83	23			

Research question two

The effect of AR and VR scaffoldings across different language proficiency levels was investigated. The K-S normality assumption was met ($p = .200$, $p < .05$). Levene's Test for Equality of Variances ($p = .531$, $p < .05$) illustrated the homogeneity of the participants, and independent sample t-test for the high and low proficiency groups of VR was conducted. The comparison between the high and low proficiency groups in the VR (Table 6) showed that the high proficiency group (*M*=

36.00, *SD*=4.83) reported better results compared to the low proficiency group (*M*=31.00, *SD*=6.83). However, no significant difference in scores for the two groups (Table 7) was unraveled; t (6)= 1.19, p=.277 (2-tailed).

The normality of the data was demonstrated using K-S normality index ($p = .200$, $p < .05$). To compare the high and low proficiency subjects in the AR group, Levene's Test for Equality of Variances ($p = .531$, $p < .05$) showed homogeneous participants. Independent sample t-test for the high and low proficiency groups of AR demonstrated that unlike the VR group (Table 6), AR group yielded better results for the low proficiency group (*M*= 40.75, *SD*=2.87) in comparison with high proficiency group (*M*=37.75, *SD*=3.86). Like the VR group, no significant difference was also observed for the two groups (Table 7); t (6) = 1.24, p= .259 (2-tailed).

Table 6

Descriptive Statistics for the High and Low Proficiencies of VR and AR Groups

	group	N	M	SD	SEM
VR	high proficiency	4	36.00	4.83	2.41
	low proficiency	4	31.00	6.83	3.41
AR	high proficiency	4	37.75	3.86	1.93
	low proficiency	4	40.75	2.87	1.43

Table 7

Independent Sample T-Test for the High and Low Proficiencies of VR and AR Groups

	Levene's Test for Equality of Variances	t-test for Equality of Means

		F	Sig.	t	df	Sig. (2-tailed)	MD
VR	Equal variances assumed	.443	.531	1.19	6	.277	5.00
AR	Equal variances assumed	.536	.492	-1.24	6	.259	-3.00

Table 8 demonstrates the descriptive statistics for the function, tense, and vocabulary of the three AR, VR, and paper-based groups. The AR group showed the superiority of function (M = 17) and vocabulary (M = 16.75) compared to tense. However, paper-based group revealed better results for tense (M = 6.75).

Table 8

Descriptive Statistics for the Three AR, VR, Paper-based Groups in terms of the Components of Each Sub-move

	Group	M	SD	N
function	VR	14.37	3.96	8
	AR	17.00	2.72	8
	paper	14.25	3.01	8
	Total	15.20	3.38	24
Tense	VR	5.37	1.30	8
	AR	5.50	1.92	8
	paper	6.75	1.66	8
	Total	5.87	1.70	24
Vocab	VR	13.87	6.10	8
	AR	16.75	3.41	8
	paper	14.00	9.31	8
	Total	14.87	6.56	24

To compare the scores across the high and low proficiency, Table 9 shows that the high proficiency groups were better than their lower counterpart in the three function, tense, and vocabulary, except for the function subcomponent of AR and paper-based groups and tense component of AR. In other words, proficiency does not play a role for the AR group compared to VR and paper-based groups for the function and tense. Likewise, proficiency does not play a role for the paper-based group for the function.

Table 9

Descriptive Statistics for the Three AR, VR, Paper-based Groups in terms of the Components of Each sub-move across low and high proficiencies

	group	M	SD	N
function	VRH	15.75	3.86	4
	VRL	13.00	4.08	4
	ARH	16.00	3.16	4
	ARL	18.00	2.16	4
	paper H	13.50	1.73	4
	paperL	15.00	4.08	4
	Total	15.20	3.38	24
Tense	VRH	5.75	.50	4
	VRL	5.00	1.82	4
	ARH	4.75	.95	4
	ARL	6.25	2.50	4
	paper H	7.00	2.16	4
	paperL	6.50	1.29	4
	Total	5.87	1.70	24
Vocabulary	VRH	14.50	6.19	4
	VRL	13.25	6.89	4
	ARH	17.00	2.82	4

	ARL	16.50	4.35	4
	Paper H	15.75	12.86	4
	paperL	12.25	5.37	4
	Total	14.87	6.56	24

*Note. *H: high proficiency; L.: low proficiency*

Research question three

To answer the third question, the AR questionnaire was administered to the AR group after the experiment. The AR subjects' perceptions were evaluated through eight Likert-scale questions and some open-ended questions. The descriptive statistics for the eight questions are demonstrated in Table 10. Among the questions, the subjects were very pleased to use the AR system for writing; however, they did not like to use the AR system for their abstract writing tasks. For the high proficiency group, although they were pleased to use the AR system for their writing, they were dubious in its usefulness to assist their writing. Low proficiency group, on the other hand, was pleased with the AR system but could not use the AR system well. This finding supports the previous research by Di Serio, Ibanez, and Kloos (2013) who detected that having experience in implementing the AR technology can be a determining factor in obtaining positive results.

Their feedback was also investigated for the high and low proficiency groups. The data obtained from independent sample t-test (Table 11) demonstrates that although high proficiency group had better perceptions towards AR compared to low proficiency group, no significant result was shown. Thus, the perceptions of the learners do not change significantly by proficiency.

Table 10

Descriptive Statistics for the AR Questionnaire across High and Low Proficiencies

	MH*	SDH*	ML*	SDL*	MB*	SDB*
Q1	4.50	.57	5.00	.00	4.75	.46

Q2	4.00	.81	2.75	.95	3.37	1.06
Q3	4.00	1.41	3.75	.95	3.87	1.12
Q4	3.75	.95	2.25	.50	3.00	1.06
Q5	4.00	.81	3.50	1.00	3.75	.88
Q6	3.50	.57	4.50	1.00	4.00	.92
Q7	4.00	1.41	3.50	1.73	3.75	1.48
Q8	3.00	1.15	4.00	1.41	3.50	1.30
Total						
	30.75	3.59	29.25	3.59	30	2.82

*Note. *H: high proficiency; L.: low proficiency; B.: both proficiencies*

Table 11

Independent Sample T-Test for the AR Questionnaire across High and Low Proficiencies

		Levene's Test for Equality of Variances		t-test for Equality of Means			
		F	Sig.	t	df	Sig. (2-tailed)	MD
perception	Equal variances assumed	1.14	.32	.72	6	.496	1.50

The feedback of the AR group was also investigated through open-ended question. Analyzing their responses, the open-ended questions showed that this recent technology was very intriguing for them. Most of the subjects did not know that abstract writing had a model to be obeyed and they previously used haphazard sentences.

Discussion

The inseparability of technology and learning is distributed to many educational fields like academic writing. Genre learning, in this regard, has been the attention of many CALL and MALL researchers and developers. The current study worked on a newer branch of CALL, that is AR, along with VR. AR as a combinatory tool attempts to delve some digital elements into the real world environment, while VR seeks to delve the individual into the digital environment. AR technology was implemented through *Ownar* mobile application in order to cover the printed out papers with a cloth of digital environment. The achievement as well as the perceptions of the subjects came into scrutiny. To investigate the effect of AR-based and VR-based scaffolding on learning generic structure of abstracts of RAs by EFL learners, three research hypotheses were formulated.

The first question examined if AR and VR learning resources significantly improved abstract writing skill participants within MALL environment. The generic structure of abstracts of RAs for both AR and VR groups were investigated. The results of this study indicate that AR group revealed significant result for the pretest, posttest, and delayed posttest. Although removal of AR scaffolding was beneficial for obtaining better results, longer removal yielded the RA abstracts weaker. VR scaffolding, on the other hand, just noted significant priority for the posttest and delayed posttest. However, like AR, removing VR scaffoldings for a longer term brought not better results. To compare the three groups of AR, VR, and paper-based groups, an unexpected outcome was obtained. The results might be attributed to the time allocated to teaching each sub-move. Few explanations and examples for each sub-move could be among the other reasons for such results.

Besides, in the current study, we used AR scaffolding for teaching the structure and vocabulary of abstract writing (i.e., an abstract idea) which yielded better results. This is at odds with the study by Wang (2017a) who knew AR scaffolding just for remembering experiences in writing not for rhetoric and syntax teaching. In other words, this paper invented a new way to teach abstract ideas with the integration of technology which was previously restricted to traditional teachers and paper-based treatment. No significant difference was obtained between the groups, although the mean score of the AR group was superior to the VR and paper-based scaffoldings.

The second question examined the effect of AR and VR scaffoldings on improving the abstract writing skill of the participants across different language proficiency levels. Proficiency was not a valuable and significant variable for the AR and VR groups. In other words, high and low proficiency groups were not significantly different from each other. However, unlike AR group, the findings for the VR group was superior for the high proficiency subjects. To sum up, higher or lower proficiency subjects were not significantly different in the AR or VR scaffoldings, with a higher mean score for the low proficiency AR learners. This finding is in agreement with Wang (2017a, p. 11) findings which showed that 'AR tools are useful for intermediate-level learners, but might not be sufficient for high-level students.' A possible explanation for this might be that intermediate students regardless of their higher or lower proficiency are seeking to learn independently without taking into account the mode of scaffolding presented to them.

In a sharper lens, we can observe the behavior of the subcomponents of each sub-move across the three groups and high and low proficiencies. The participants for the AR group were better in the function and vocabulary of the sub-moves of abstract writing. However, paper-based group could perform better in the tense of the sub-moves. Across the different proficiencies, high proficiency subjects were generally better in using the function, tense, and vocabularies; however, for the AR, tense and for the AR and paper-based groups, function was better for the low proficiency group. In general, all groups showed RA abstract improvement which further support the idea of Hayes and Flower’s (1980) who found out that writing help can make the learners' thoughts come into practice.

The third question was about the way the AR group perceived using AR in MALL environment. AR regarded no significant superiority for higher proficiency subjects. The AR subjects were very pleased to use the AR system for writing. They reflected that the provided chunks and vocabularies were very useful for their writing. However, they mentioned that the small size of their mobiles did not allow them to watch the videos well. They also reported that the logistics of the provided pictures and chunks were good since they could become fit with the mobile screen. They suggested if the system could make the videos fit their mobiles, as well.

An interesting writing activity was another point they highlighted. Furthermore, they noted the fixation of the pictures on the system as a good point. This was in line with the previous suggestion by Wang (2017a, p.10) who commented that 'if the purpose of the AR-based system was to act as writing scaffolding, then the supported materials should be continually presented so that the learners could reference the scaffolding when they needed it.'

Besides, the high proficiency group reflected that AR system could not make them invent novel sentences and they were in a closed environment. They also criticized about the few elaborating contents for each sub-move. The low proficiency group, on the other hand, mentioned the few number of sessions they needed to practice. They also mentioned the writing tasks they were to do at each session since the continuous act of writing was somehow challenging for them. In addition, the low proficiency group expressed their higher motivation and satisfaction towards this interesting and convenient technology. This is consistent with the findings of Wang (2017a) who found higher motivation and engagement as the byproducts of AR in the instruction practices.

Conclusion

AR and VR technologies are a matter of changing or substituting the real environment. To associate genre knowledge with these two digital tools, the current study explored the differences of three types of scaffolding in writing English RA abstracts and the perceptions of the AR group. Hyland's (2000) model of move analysis was applied to teach and analyze the abstracts. The pretest, posttest, and delayed posttest were carried out in order to examine their generic abstract achievement for the three groups across high and low intermediate proficiencies and the way the AR group realized working with the system. The findings demonstrated that intermediate proficiency subjects did not show any significant difference after they used AR, VR, and paper-based scaffoldings. Furthermore, higher or lower proficiency subjects were also not significantly different from each other in using AR or VR scaffoldings, however, the mean score of lower proficiency was higher for the AR group.

Besides, although the different types of scaffoldings were not significantly different, the use of AR techniques yielded better RA abstracts compared to VR- and paper-based groups. However, although AR group performed better than the other two groups, in analyzing their results further, it might be unraveled that this type of scaffolding was more effective for the low intermediate proficiency subjects in using the proper function and tense of the sub-moves. Since function is the basic rhetorical conception of a sub-move and tense is its more superficial conception, it can be confessed that lower proficiency learners could better learn through the way AR mixes real and virtual but not through complete real or virtual environments. Low proficiency group mentioned their satisfaction in using AR as an interesting and convenient technology which simulates another world onto the real papers. However, regardless of the proficiency, the mere abstract modeling in abstract writing and embedding it in the nutshell of AR was the common point most AR subjects brought into our attention. Besides, both proficiencies mentioned enriching their short term memory with the chunks and vocabularies as its advantage.

Implications

AR is an interesting and recent technology which can provide the learners with new experiences. Integration of real and unreal worlds can be used in teaching the generic writing skill which might be a difficult skill to learn for lower proficiency learners. Although lower-level students might not learn the language specifics of a genre well, the rhetorical structure can be absorbed to assist them while writing. Thus, this finding has important implications for teachers to use AR resources in a collaborative environment. Furthermore, the combination of findings suggest that teachers can teach the rhetorical structure and syntax in a writing course through AR environment which was previously more suitable for traditional and paper-based teaching.

Limitations of the study

A number of caveats need to be noted regarding the present study. An important limitation lies in the number of sessions devoted to each scaffoldings and the number of subjects in each group. The logistics issues of mobile phones such as the small screen size and internet speed are among the other of the limitations. Besides, an issue that was not addressed was a diverse set of linguistic phrases which can be used for each sub-move.

Suggestions for further study

More engagement with the scaffoldings are needed to claim the superiority of AR or other scaffoldings in improving the generic structure of abstracts of research articles (RAs). Besides, students from different levels of proficiency and writings from different genres can be examined. Further research should be done to investigate the suitability of CALL scaffoldings for teaching writing in general and genre awareness, in particular.

References

Azuma, R. (1997). A survey of augmented reality. *Presence*, *6*, 355–385. Retrieved from https://doi.org/10.1162/pres.1997.6.4.355

Bacca, J., Baldiris, S., Fabregat, R., & Graf, S. (2015). Mobile augmented reality in vocational education and training. *Procedia Computer Science, 75*, 49-58.

Bhatia, V. (1994). *Analyzing genre: Language use in professional setting*. London: Longman.

Billinghurst, M., & Duenser, A. (2012). Augmented reality in the classroom. *Computer*, *45*, 56–63. doi**:** 10.1109/MC.2012.111

Bitter, G. & Corral, A. (2014). Potential of Augmented Reality Apps. *International Journal of Engineering Science Invention*, *3(10)*, 13-17.

Bower, M., Howe, C., McCredie, N., Robinson, A., & Grover, D. (2014). Augmented reality in education—Cases, places, and potentials. *Educational Media International*, *51*, 1-15. Retrived from https://doi.org/10.1080/09523987.2014.889400

Chang, H.Y., Yu, Y. T., Wu, H. K., & Hsu, Y. H. (2016). The impact of a mobile augmented reality game. The 16th IEEE International Conference on Advanced Learning Technologies, USA (312-313).

Chen, C.-M., & Tsai, Y.-N. (2012). Interactive augmented reality system for enhancing library instruction in elementary schools. *Computers & Education, 59,* 638–652. doi: 10.1016/j.compedu.2012.03.001

Chen, D. R., Chen, M. Y., Huang, T. C., & Hsu, W. P. (2013). Developing a mobile learning system in augmented reality context. *International Journal of Distributed Sensor Networks*, *9*(12), 594627. doi: 10.1155/2013/594627

Cifuentes, S.C., Garcia, S. G., Andrés-Sebastia, M. P., Camba, J. D., & Contero, M. (2016). Augmented reality experiences in therapeutic pedagogy for special needs students. The 16th IEEE International Conference on Advanced Learning Technologies, USA (431-435).

Dede, C. (2009). Immersive interfaces for engagement and learning. *Science, 323,* 66–69. doi: 10.1126/science.1167311

Di Serio, A., Ibanez, M. B., & Kloos, C. D. (2013). Impact of an Augmented Reality System on Students' Motivation for a Visual Arts Course. *Computers & Education, 68,* 586-596.

Dos Santos, M. B. (1996). The textual organization of research paper abstracts in applied linguistics. *Text-Interdisciplinary Journal for the Study of Discourse*, *16*(4), 481-500. doi: 10.1515/text.1.1996.16.4.481

Dunleavy, M., Dede, C., & Mitchell, R. (2009). Affordances and limitations of immersive participatory augmented reality simulations for teaching and learning. *Journal of Science Education and Technology*, *18*, 7–22. doi: 10.1007/s10956-008-9119-1

Gong, C., Tan, C. L., & Chin, C. K. (2018). Scaffolding Instruction of Chinese Essay Writing with Assessment as Learning. In *Teaching Chinese Language in Singapore* (pp. 121-134). Springer, Singapore.

Hayes, J. R., & Flower, L.S. (1980). Identifying the organization of writing processes. In L. W. Gregg & E. R. Steinberg (Eds.), *Cognitive process in writing* (pp. 1-30). Hillsdale, NJ: Lawrene Erlbaum Associates.

Hyland, K. (2000). *Disciplinary discourses: Social interactions in academic writing*. London: Longman.

Hyland, K. (2002). *Teaching and researching writing*. London: Pearson Education.

Jerry, T., & Aaron, C. (2010). The impact of augmented reality software with inquiry-based learning on students' learning of kinematics graph. In 2nd International Conference on Education Technology and Computer (ICETC), 2010 (pp. V2-1–V2-5). Shanghai: IEEE.

Johnson, L., Smith, R., Levine, A., & Haywood, K. (2010). The 2010 Horizon Report: Australia-New Zealand Edition. Austin, Texas: The New Media Consortium.

Kerawalla, L., Luckin, R., Seljeflot, S., & Woolard, A. (2006). Making it real: Exploring the potential of augmented reality for teaching primary school science. *Virtual Reality, 10*, 163–174. doi: 10.1007/s10055-006-0036-4

Klopfer, E., & Squire, K. (2008). Environmental detectives – The development of an augmented reality platform for environmental simulations. *Educational Technology Research and Development*, 56, 203–228. doi: 10.1007/s11423-007-9037-6

Koschmann, T. (2002, January). Dewey's contribution to the foundations of CSCL research. In *Proceedings of the Conference on Computer Support for Collaborative Learning: Foundations for a CSCL Community* (pp. 17-22). International Society of the Learning Sciences.

Kroeker, K. L. (2010). Mainstreaming augmented reality. *Communications of the ACM*, *53*, 19–21. doi: 10.1145/1785414.1785422

Lee, K. (2012). Augmented reality in education and training. *Tech Trends*, *56*, 13–21. doi: 10.1007/s11528-012-0559-3

Li, M. (2018). Computer-mediated collaborative writing in L2 contexts: an analysis of empirical research. *Computer Assisted Language Learning*, 1-23. doi: 10.1080/09588221.2018.1465981

Matcha, W. & Awang Rambli, D. R. (2011). Preliminary investigation on the use of augmented reality in collaborative learning. *Communications in Computer and Information Science, 254*(4),189-198. doi: 10.1007/978-3-642-25483-3_15

Milgram, P., & Kishino, F. (1994). A taxonomy of mixed reality visual displays. *IEICE TRANSACTIONS on Information and Systems*, *77*(12), 1321-1329.

Rasimah, C., Ahmad, A., & Zaman, H. (2011). Evaluation of user acceptance of mixed reality technology. *Australasian Journal of Educational Technology*, *27*, 1369–1387. doi: 10.14742/ajet.899

Rice, J. W. (2007). New media resistance: Barriers to implementation of computer video games in the classroom. *Journal of Educational Multimedia and Hypermedia,16 (3),* 249-261. Retrieved from https://www.learntechlib.org/primary/p/24378/.

Samraj, B. (2005). An exploration of a genre set: Research article abstracts and introductions in two disciplines. *English for Specific Purposes*, *24* (2), 141-156. doi: 10.1016/j.esp.2002.10.001

Shelton, B. E. (2002). Augmented reality and education: Current projects and the potential for classroom learning. *New Horizons for Learning*, *9*(1). Retrieved from http://inst.usu.edu/~bshelton/resources/shelton-NH_aug_real.pdf

Specht, M., Ternier, S., & Greller, W. (2011). Mobile Augmented Reality for Learning: A Case Study. *Journal of the Research Center for Educational Technology, 7(1),* 117-127.

Squire, K., & Jan, M. (2007). Mad City mystery: Developing scientific argumentation skills with a place-based augmented reality game on handheld computers. *Journal of Science Education and Technology*, *16*, 5–29. doi: 10.1007/s10956-006-9037-z

Storch, N. (2013). *Collaborative writing in L2 classrooms*. Bristol, UK: Multilingual Matters.

Sutherland, I. E. (1968, December). A head-mounted three dimensional display. In *Proceedings of the December 9-11, 1968, fall joint computer conference, part I* (pp. 757-764). ACM.

Swales, J. (1981). *Aspects of article introductions*. Birmingham: The University of Aston, Language Studies Unit.

Swales, J. (1990). *Genre analysis*. Cambridge University Press.

Swales, J. M. (2004). *Research genres: Explorations and applications*. New York: Cambridge University Press.

Tarng, W., & Ou, K. L. (2012, March). A study of campus butterfly ecology learning system based on augmented reality and mobile learning. In *2012*

IEEE Seventh International Conference on Wireless, Mobile and Ubiquitous Technology in Education (pp. 62-66). IEEE.

Ting, H. Y. (2015). *The effects of applying augmented reality on fourth-grade students' writing and attitude* (Unpublished master's dissertation). National Taipei Education University. Da'an District, Taipei, Taiwan.

Vygotsky, L.S. (1978). Mind in society: *The development of higher psychological processes*. Cambridge, MA: Harvard University Press.

Wang, Y. H. (2017a). Exploring the effectiveness of integrating augmented reality-based materials to support writing activities. *Computers & Education*, *113*, 162-176. doi: 10.1016/j.compedu.2017.04.013.

Wang, Y. H. (2017b). Using augmented reality to support a software editing course for college students. *Journal of Computer Assisted Learning*, *33*(5), 532-546. doi: 10.1111/jcal.12199

Appendix

AR Scaffolding Writing Questionnaire

1. I am pleased to use the AR system for writing.
2. I could use the AR system well.
3. The AR system is helpful in guiding me to do the abstract writing tasks.
4. I like to use the AR system in doing the abstract writing tasks.
5. The AR system enriched my ideas in doing the abstract writing tasks.
6. Using the AR system enhances my writing motivation.
7. I like to use the AR system for writing in general.
8. I think using the AR system is useful to assist writing.