



Augmented Reality and Virtual Reality in a Collective Scaffolding Platform: Abstract Genre Structure in a Mobile-Assisted Language Learning Study

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Abstract

The increasing interest in new technologies and collaboration has created innovative ways in learning. Among these, computer-supported collaborative learning has received much attention where collaborative learners interact with their peers in a meaning-making process with the help of computer technologies. The present study attempts to understand the interaction pattern among collaborating intermediate EFL students who use augmented reality and virtual reality learning resources in the meaning-making process of abstract genre awareness. Augmented reality integrates the virtual with the real environment, while virtual reality immerses the learners in the virtual world. To this end, twelve intermediate proficiency pairs were randomly assigned into three scaffolding groups: Augmented reality, virtual reality, and traditional. Each group was supposed to write an abstract upon the provided resources which were prepared based on the sub-moves of Hyland's (2000) move analysis model. The augmented reality group used Ownar mobile application and the virtual reality group used VR HeadSet virtual reality. The audio recordings of the participants' interactions during their collaborative abstract writing with the help of the assigned scaffoldings confirmed Hsieh's (2017) collective scaffolding in achieving high quality collaboration: Peer to peer, multi-directional, and individual scaffolding pattern. The augmented reality group demonstrated peer to peer scaffolding pattern; the virtual reality group demonstrated multi-directional pattern, and the traditional group demonstrated individual scaffolding pattern. It is implicated that practitioners can reinforce these types of scaffoldings in order to enhance assistance, co-construction, and accuracy among the peers through using augmented reality, virtual reality, and traditional group scaffolding, respectively.

Keywords: Abstract Genre Structure, Augmented Reality, Collective Scaffolding

Received 02 December 2019

Accepted 01 March 2020

Available online 10 June 2020

DOI: 10.30479/jmrels.2020.12085.1503

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1. Introduction

Collaborative learning as one of the demonstrations of Vygotsky's sociocultural theory lays importance on the social creation of knowledge. Swain (2010) believes that the *linguaging* peers use during the dialogues (i.e., sharing, refining, and elaborating information among each other) makes them understand the materials better and in effect construct their knowledge. Linguaging, as such, is responsible for the understanding, learning, and higher order thinking. However, the basic skeleton around which this linguaging occurs is scaffolding. The scaffolding can be provided through an expert or teacher (Vygotsky, 1978), peers (Crook, 1994; Donato, 1994), and technology including the educational software (Gutierrez, 2006; Mavrou, Leewis & Douglas, 2010) or the Internet (Hughes, 2013; Peters, Weinberg, Sarma, & Fankoff, 2011). The provided scaffoldings can heighten the performance of the learners in a collaborative learning environment. Technology-based scaffoldings, in fact, came into existence with the advent of computer-supported collaborative learning (CSCL) which stimulated many studies to be carried out. In fact, it underscores the way learners learn collaboratively with the support of computers or digital technologies (Koschmann, 2002; Stahl, Koschmann, & Suthers, 2006; Suthers, 2006). Hannafin and Land (1997) believe that "Scaffolding... is not limited solely to student-student and teacher-student interactions. Rather, technology-enhanced environments often provide the conceptual scaffolding and means (resources, tools) to promote personal and individual reflection" (p. 194).

In the past two decades, a number of researchers have sought to determine the way peer-to-peer and technology-based scaffoldings behave in enhancing learning, applying the technologies to allow the collaboration (Kessler, Bikowski, & Boggs, 2012; Stahl et al., 2006) as well as software (Lipponen & Lallimo, 2004). Alongside the studies which used predesigned scaffoldings in the form of educational software, the current study intends to examine how collaborating peers, through a meaning-making process, use mixed reality and virtual reality technology resources to collectively make shared understandings. In other words, the present study attempts to use augmented reality (AR) and virtual reality (VR) technologies in order to delve into another technology used in the interactive platform. However, in order to find out how AR and VR scaffoldings contribute to collaborating learners to reach a common understanding, we resorted to writing the abstract of research articles (abstract genre and moves in particular) as the context in which peers might demonstrate their understandings.

2. Literature Review

2.1. Collaborative Writing

Many studies conducted on collaborative learning, describing the way learners help each other in progressing their developmental level to surpass from a lower level to a higher one, perceived as the *zone of proximal development* (ZPD, Vygotsky, 1978). Ohta (2001) explains the ZPD as "the distance between the actual developmental level as determined by individual linguistic production, and the level of potential development as determined through language produced collaboratively with a teacher or peer" (p. 9). Although Storch (2005) states that the important parts of collaboration are mutual generation and finding out different views of their peers, many researchers attempted to reveal the patterns of discourse in which such scaffoldings occur. To de Guerrero and Villamil (2000), bidirectional engagement, talking about diverse opinions, explanation, modelling, L1 using, and reaching a common point in discussions are important in scaffolding learners' joint construction of knowledge. Donato (1994) knows this as *collective scaffolding* during which the following patterns can be observed: Collective co-construction, explicit requests for assistance, questioning competing forms, jointly managing components of the problem, other-or self-correction, and private speech (de Guerrero & Villamil, 2000; Donato, 1988, 1994; Foster & Ohta, 2005; Ohta, 1995, 2001). Likewise, Foster and Ohta (2005) hold more general behaviors of co-construction, incorporation of language, other-correction, and self-correction as the discourse which is created during collaborative learning.

Swain and Lapkin (1998) did another interaction discourse analysis in writing and found that collaborating learners in their language-related episodes (LREs) use the following collaborative discourse in their writings: "talk about the language they are producing, question their language use, or correct themselves or others" (p. 326). However, the current study intends to achieve another model of collaborating writing using collective scaffolding model (Donato, 1994) and the LREs (Swain & Lapkin, 1998).

2.2. Augmented Reality and Virtual Reality

Virtual Reality (VR) as the simulation offered by virtual environments attempts to diminish the borders between real and virtual worlds. Immersing the individual in an unreal world dates back to the 60s when learners needed to use special electronic equipment in order to delve into such environments. Gradually, VR gained more popularity and it was applied in more handheld apparatus.

More recently, blending the real and virtual environments has become the focus of many studies. Augmented Reality (AR) can put real and virtual objects together in a real time interaction (Azuma, 1997). This rich

environment with its combinatory nature provides the learners with multimedia data which can help learners in their learning tasks (Billinghurst, Kato, & Poupyrev, 2001). Many researchers believe that enabling learners to perceive real and virtual worlds simultaneously through AR might have many benefits for them in education (Billinghurst & Duenser, 2012; Johnson, Adams, & Cummins, 2012).

Milgram and Kishino (1994) put these two environments along a continuum. This virtuality continuum (Figure 1) demonstrates where the real and virtual and the mixed reality locate. Mixed reality is defined as AR and augmented virtuality, that is, the addition of the virtual to real objects and the real to virtual objects, respectively. Augmented Reality as a type of mixed reality which infuses digital with real objects is different from VR in that it fertilizes the interaction of real and digital data in real time (Azuma, 1997).

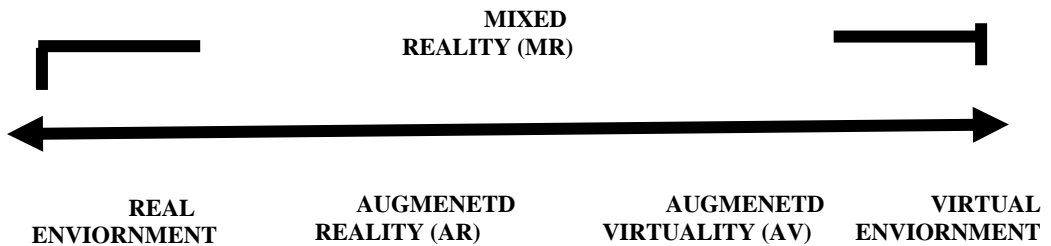


Figure 1. Milgram and Kishino's (1994) Reality-virtuality Continuum

Due to the recognition these modern technologies in the learning fields, some studies have been conducted in diverse fields of studies like electronic education, medical science, psychology, geography, tourism, sport, art, and language learning. They, in fact, elaborate on the role of AR and VR as digital affordances in theoretical and practical branches of learning. Bower et al. (2014) enumerate some AR software like Wikitude, Plane Finder AR (over imposing the distinctive information of any plane on the plane observed), Worksnuq (superimposing the information of the wifi found on the mobile camera), SekaiCamera (allowing the individuals to have "airnotes" on the locations they find and put them disposable to other people), and StreetTag (superimposing a graffiti layer on the world in order to let the individuals to have their street art). LearnAR as one of these software contains a box of 10 marker-based AR learning experiences which holds different fields of biology, physics, languages, English, mathematics, and religion in itself. Fetch lunch is another software which maneuver on basic mathematics skills. Furthermore, Zooburst attempts to take photos, texts, and audio and have 3D digital stories as its output. Wordlens in language learning is included as the supporting software which (Bower et al., 2014) puts language translations on the learning materials (Bower et al.,

2014). In the field of language learning, and in particular, few studies have been carried out in the field. In improving the Chinese writing skill using AR, Ting (2015) examined elementary school students. In fact, he compared picture-based and AR-based techniques of teaching writing and found out that AR might not have significant results in the skill and content of writing. Along the same lines, Wang (2017a) compared AR-based learning material with paper-based supports and only paper-based writing support in order to unravel if they improve the learners' Chinese writing skill. His 30 twelfth-grade students became adept at content control, article structure, and wordings but low-achiever learners could begin their writing and with richer outlining. Wang (2017b) worked on more affective domains in college students comparing the two online-based and AR-based groups. The AR group demonstrated higher motivation, engagement, involvement, and peer interaction. By the way, some limitations such as the needed experience to use AR, logistics problems, and cognitive load of AR information were enumerated.

VR, on the other hand, is included among the useful technologies in language education (Peterson, 2006). Interaction in another language and collaboration with each other can be among the benefits of teaching and learning in virtual world (Chen, 2016). Acts like virtual trips or role playing can be the demonstrations of this extraordinary world by which education can be accomplished in VR. In addition, the involvement and the negotiation of meaning in this world are the motives behind the efficiency of VR in the language learning field (Chen, 2016). In fact, the virtual simulations (Svensson, 2003) and the visualization created by this world can bring about a different rich educational platform. For example, Thorsteinsson and Page (2008) used SmartVR to make learners have cognitive conflicts and disequilibrium in their tasks in an online course to have them test other points of view. Si (2015) investigated 20 native English children who learned Mandarin Chinese language. It was revealed that Unity as the 3D platform could enhance the learners' engagement, vocabulary repertoire, and speaking skills. On the other hand, Wang et al. (2017) attempted to combine the virtual environment with other facilities of chatbox and time machine in the 3D platform of OpenSimulator in language learning area. They understood that the native Chinese speakers who witnessed the virtual environment with chatbox and time machine behaved significantly better in perceiving immersion and presence. In another study on learning L2 vocabulary, Legault et al. (2019) compared immersive VR and word-word paired association conditions and unraveled that accuracy could be more prominent for the immersive VR condition compared to the word-word condition. On the other side of the coin, they found out that immersive VR condition had more discriminatory power to separate more and less successful students from each other compared to the word-word condition. In general, AR and VR due to

the involvement and immersion they produce can provide rich and fruitful learning contexts for the pedagogical parties.

2.1.1. Computer-supported Collaborative Learning (CSCL)

Computer-supported collaborative learning (CSCL) intends to examine how collaborative learners interact with each other in a meaning-making process with the help of computer technologies (Koschmann, 2002). CSCL uses the innovative technology to scaffold learners in online written interactions (Kessler et al. 2012; Li & Zhu, 2013), online oral interactions (Jepson, 2005; Yanguas, 2010), and face-to-face interactions (Mavrou et al., 2010).

During the past decades, some researchers examined the interaction patterns of the collaborative learners in computer-mediated collaborative writing (CMCW). Li and Zhu (2013), in a Wiki-based collaborative writing, found that Wikis could not only help learners have mutual understandings in their writing, but also supported their revision as well. In a Web-based word processing tool context, Kessler et al. (2012) found that learners in an online collaborating revising writing could benefit from such tool in collective scaffolding discourse. In another study, Cho (2017) conducted a research on 12 ESL tertiary students in Canada in order to understand how Google docs might scaffold learners in a writing task. The interaction patterns of their archived Google docs demonstrated that "modes of communication, task representations, matches/mismatches between participants' self-perceived and other-perceived roles, and perceptions of peer feedback were the primary mediating factors on the qualities of collaboration" (p. 37).

Hsieh (2017) also in a case study in an Internet-enhanced and face-to-face collaborative situation conducted an experiment on four graduate-level ESL learners to reveal their patterns of interaction. He found that the interactions with peers and online technologies "can facilitate critical scaffolding in learners' interaction and knowledge construction, which also encourages collaborative learner autonomy" (p.1). He also found the three scaffolding patterns of peer-to-peer, multi-directional, and individual scaffoldings.

Likewise, Li and Zhu (2017) studied the Wikispaces of 12 ESL post graduate students in the USA in writing research proposals of three-member small groups. Their patterns of interaction was collective pattern in a Research Proposal Task and active-withdrawn pattern in an Annotated Bibliography Task for the first group; dominant-defensive pattern in a Research Proposal Task and a collaborative pattern in an Annotated Bibliography Task for the second group.

Bradley, Lindstrom, and Rystedt (2010) explored the interaction patterns of 56 ESP students in Wikispaces. Their writing task unraveled two kinds of contributing patterns in their Wikis: Co-operative and collaborative. By cooperation, they meant "students expressed their views in a dialogic mode, taking turns at posting ideas". By collaboration, they meant "students produced joint texts and then made alterations and additions."

In another study on collaborative writing, Abrams (2016) explored the creative writings of 28 tertiary German foreign language students who used Google docs during their process writing. The participants' archived Google docs records demonstrated their "participatory patterns along the axes of equality and mutuality" (p. 1). In other words, they found three main patterns of low, sequentially additive, and collaborative participation.

In the related literature, we noticed a dearth of studies in learners' interaction with the pre-designed fixed content technologies in a meaning-making process via of AR and VR. Although it has been revealed that AR and VR technologies were beneficial in learning, to the best of the researchers' knowledge, no studies have explored them in CMCW to elaborate on the way collaborating learners use such technologies to come into a shared understanding. In particular, the present study intends to examine the collaborative face-to-face interaction of the peers in AR and VR environments in teaching abstract writing. Following Gutierrez (2006), to analyze the interaction patterns of the peers' interactions, we used a sociocultural perspective applying the high quality collaboration (HQC) concept to delve more into the learners' interactions in their collaborative abstract writing task via AR and VR scaffoldings. HQC which can be the product of collective scaffolding (Donato, 1994) is aimed to help us in unraveling the patterns of scaffolding to come to a shared understanding between learners.

To design the content aspect of CSCW in its writing platform, we used the abstract genre of research articles in Applied Linguistics. The abstract was selected for the study since we believe it plays a key role in the acceptance of articles in valid journals. This summary function genre (an abstract), described by Swales (1990) as the "first impression" of an article, has been a major concern to many writing researchers, and learning abstract moves and sub-moves is essential as a "time-saving device" (Martin, 2003) which determines the possibility of its reading (Hyland, 2002). As abstracts are composed of different models including various moves and steps, this study focuses on Hyland's (2000) model of move analysis which entails as the following: Introduction, purpose, method, product, and conclusion. The present study delves in to an interactive platform utilizing AR and VR technologies in order reveal their behavior in a meaning-making process

through writing RA abstracts (abstract genre and moves in particular). To this end, the following question was addressed:

1. How do collaborating intermediate EFL students use AR and VR scaffoldings to build shared understandings in the meaning-making process in a collective scaffolding platform?

3. Method

3.1. Participants

The participants were 24 intermediate EFL learners registered for an advanced research course in the Summer semester in a university in Iran in 2018. The participants were selected from a group of 30 MA female students with similar range of scores in TOEFL, writing proficiency, and abstract writing (i.e., 460-490; four to six; 20-60 respectively). The participants' age ranged between 22-31 years ($M = 26.6$; $SD = 2.76$) and they reported spending nearly 4 to 6 hours daily on their mobile. Their skill to use mobile phone was important since the scaffoldings were through mobiles. They declared they could use mobile for social networking, emails, websites, dictionaries, and other usages. This indicated that they could use their mobiles in an appropriate manner as required by the study. As the participants needed to do the assigned tasks collaboratively in pairs, the participants were classified into 12 pairs upon their TOEFL scores. To build the pairs, the participants with the highest scores were paired with the participants with the lowest scores. In a random assignment, the pairs were assigned to three AR, VR, and control groups. The AR group used AR scaffolding, the VR group used VR scaffolding, and the control group used paper-based scaffolding; each group contained four pairs of participants.

3.2. Materials

3.2.1. Tests

TOEFL PBT (2004) and its writing module were used for the purpose of students' homogeneity. Furthermore, the participants were also examined to evaluate their knowledge of abstract writing using Hyland's (2000) model of move analysis. The rubrics used for the current study assigns five points to each of the sub-moves of Hyland's (2000) model (for function we have 2 points, for tense we have one point, and for vocabulary we have 2 points). As such the complete score for each sub-move is 60 points (Table 1).

3.2.2. Augmented Reality (AR) Application

The current study used *Ownar* AR mobile application for its augmented reality (<https://cafebazaar.ir/app/com.nikmodern.ownar> for *Android* and <https://itunes.apple.com/us/app/ownar/id1247386794> for Apple's

iOS operating systems. Any application needs to go through the levels of designation, development, implementation, and evaluation in order to be operationalized. As *Ownar* AR application was already designed by the *Ownar* group, we went through the other next stages. To develop the app, we used our opinions in RA abstract. Using these opinions, we prepared the scaffoldings and uploaded them on *Ownar portal website*; different images, videos, audio, three-dimensional pictures, and social networks were inserted on a picture in order to be later read by *Ownar* AR application in the participants' phones. To implement the application, the participants needed to scan their assigned pictures through their mobile camera; in this case, superimposed virtual elements would become evident for them.

For developing the AR instrument, we used a focus group of three research professors who were asked to complete a questionnaire about the content and presentation of the materials in the application. They commented on the preparation of the sessions, their assumed cognitive load for presenting each sub-move, the quality, and the abstracts. Upon their comments, we used RA abstracts from top tier peer-reviewed ISI-indexed journals in order to present the sub-moves of an abstract. In addition, three to four linguistic chunks along with some lexical items embedded in some sentences introduced each sub-move.

As for the next step in AR instrument development, we printed the final paper products and conducted a pilot study with four students. The content, time, and examples of the sub-moves were noted to be revised. Developing the AR scaffolding, the system went to another step of implementation.

3.2.3. *Virtual Reality (VR)*

The VR group was provided with the same scaffoldings of the sub-moves of writing an abstract, with the difference that they were converted to 3D films to be watched through Virtual Reality Headset. We used P-Net VR-100 Virtual Reality Headset since it did not need special prerequisites – adaptable to both Android and iOS systems. Using the headset, the participants could touch a real learning environment which changed with their movement. After the preparation stage, the focus group of AR scaffolding experienced this 360 degrees environment as well and declared that the speed and quality of the film needed to be improved.

3.3. Procedure

The current study conforms to Chuang (2004) in knowing teachers' task introducing the rhetorical and syntactical information for writing, that is why we used AR scaffoldings in order to compensate for such task.

Working on RAs abstract sub-moves and Hyland's (2000) model of move analysis with its 12 sub-moves, our treatment was for four weeks _ four sub-moves each week. Each session, the pairs needed to write the sub-moves of a real abstract upon the scaffoldings they were presented. The first session of the treatment was allocated to the definition of an abstract, move, sub-move, and models of move analysis. The other sessions dealt with the rhetorical and syntactical data, sample sentence, and sample abstract of the sub-moves of Hyland's (2000) model.

The data collected were the audio recordings of their interaction. They could help us find out the dynamic interaction between the participants' conducting their assigned collaborative writing. Each group was assumed to write a part of an abstract collaboratively using their assigned scaffoldings in a face-to-face manner. The groups did their tasks at the same time. After administering the TOEFL and abstract writing tests, one session was devoted to train each major group the technology they needed to know in working with their own scaffoldings, the PBWiki (features and functions), and the collaborative writing. For PBWiki, the participants were instructed how to make a Wiki page with each other, write and revise their writing task, and finally share their changes with their peer (*share this page*). The participants in each pair used their own laptops; one of them created the page and invited the other member to revise it. For collaborative writing, we followed Storch's (2013) principles of collaborative writing for shared responsibility, interaction, negotiation of meaning, and making joint decision to come into a shared understanding during their meaning making process. Then, the pairs had to practice their own scaffoldings in the PBWiki environment in 15 minutes, after observing the researchers modelling the tasks. The participants worked on the tasks for four sessions. Each session, they needed to create a new shared Wiki page and construct their writing collaboratively upon the prepared scaffoldings. The treatment for each sub-move was vocabulary items, tense, and common phrases which the participants needed to do in 20 minutes.

3.3.1. Tasks

The participants in each group were assigned the same content with different modes of scaffoldings in order to learn how to write RAs abstract in pair. Each pair was asked to write the target abstract sub-moves at each session collaboratively. The AR-based group needed to scan their given paper of picture by *Ownar* application in their mobiles in order to activate their pre-designed AR facilities. Touching each symbol, the inserted content was demonstrated and they could negotiate with each other and write the target sub-moves.

The VR group, likewise, needed to write the target sub-moves with each other in a collaborative environment at each session using VR learning resources. In fact, they received the same scaffolding content with the difference that each pair experienced a different environment. The environment was operationalized using VR headsets through which the participants could watch 3D films_ the films were about the same contents of the AR group. To do so, each person, in each pair, played the film in his or her mobile phone and then inserted the phone in a VR headset. As such, they could see a 360 degrees virtual environment which contained their required learning resources for writing the sub-moves. In this case, at each session the pairs watched the prepared films of the sub-moves and wrote the target sub-moves collaboratively.

The paper-based scaffolding group had the same learning resources as well. However, the content was provided in separate printed papers. They needed to write the target sub-moves of each session collaboratively in pairs with the help of these learning resources.

3.4. Data Analysis

Transcribing the audio recordings of the pairs was used to unfold the manner in which they collaborated in their writing tasks. Following the study by Hsieh (2017), we resorted to the collective scaffolding of Donato (1994) in mining the interaction patterns of the pairs in using the scaffoldings. After transcribing, the accuracy of the transcripts was checked. The disagreements were discussed to come to a consensus. The last draft of the transcriptions was used for further analysis.

As the purpose of the study was learning abstract moves, the transcripts were categorized upon their relatedness to the provided scaffoldings in each group (AR, VR, and paper-based group) independently. The disagreements again were consulted to reach an acceptable index of reliability. Combining the collective scaffolding and abstract related scaffoldings for each group, we could examine each target transcript through the six features of collective scaffoldings in order to examine how the AR-, VR-, and paper-based scaffoldings behaved in collective scaffoldings in coming to high quality collaboration.

4. Results and Discussion

4.1. Results

The transcripts for each major group of AR-, VR-, and paper-based scaffoldings were transcribed. The four pairs in the AR group produced 42 language and abstract related transcripts; the four pairs in the VR group produced 39 language and abstract related transcript; the four pairs in the paper-based group produced 38 language and abstract related transcripts. The

related transcripts in each group were scanned with the six features of collective scaffolding by Donato (1994) in order to understand the way the three AR-, VR-, and paper-based scaffolding behave in the participants' language and abstract related interactions. For the first feature, collective co-construction, in which the pairs intended to build each other's utterances, one participant could not find a proper wording for the better description of the move and that is why her partner tends to find it via the provided scaffoldings. After that the pairs agreed on one statement, the writing goes on. As such, in the realm of related languaging, the pair could come to the common point of HQC (Gutierrez, 2006) in the road of achieving *cohesion*. Thus, the technological scaffoldings could have an important part in this domain.

For the second feature, requesting assistance, in which one partner requested for help implicitly in writing a proper sentence for one sub-move and another partner tries to help her via the provided scaffoldings. The second person firstly attempts to find the location of information and then suggests some appropriate words from which the first person can choose from. As such, the scaffoldings could help the pair fulfill her partner's request.

For the third feature, questioning competing forms, in which one partner declared that she did not know which tense is grammatical for a specified sub-move and asked her partner about it; this corresponds with what Donato (1994) states about the role of questions in language learning. Thus, her partner searched for the specified information in the scaffoldings and showed her partner the case because she did not know which tense to use. This could help both understand the proper competing form for the specified sub-move in order to submit a more grammatical abstract. Therefore, the provided scaffoldings could support the pairs in coming into an agreement in language use.

For the fourth feature, jointly managing components of the problem, one of the peers declared that she did not know how to express the sub-move in an appropriate manner. To complete the joint task, using their previous knowledge and the provided scaffoldings, they attempt to find a more appropriate lexis to express the purpose and consult it with each other. Afterwards, the peers gradually jointly agreed on one lexical or grammatical feature. Thus, the interaction of the peers with the provided scaffoldings helped them jointly resolve their problem in conducting the task. Building up their thoughts about a specific purpose could help the peers come up with their writing task. For the fifth feature, other- or self-correction, the peers tend to correct each other's problems in expressing the sub-move using their own knowledge or the related scaffoldings. In self-correction, the pairs understand their problems in writing the sub-move and try to correct

themselves checking the scaffoldings. In addition, one of the pairs mentioned that she found the sample sentences as a pattern with which she could correct herself and make a more appropriate better sentence. In other words, the sample sentences could provide learners with more tangible experiences in using the target vocabularies.

For the sixth feature, private speech, in which the participants talked to themselves in description of resolving their immediate difficulties. Vygotsky (1986) believed that the driving force behind such a speech is the outside interactions. As such, we enumerated the speech which the peers talk to themselves in writing the sub-moves as private speech which the peers, in better organizing their mind, attempt to reach a stage beyond their current developmental level using the provided scaffoldings. However, this type of speech needed to be emerged by our target scaffoldings and not the interaction which the peers might have with each other.

As it was demonstrated, the interaction of the pairs with AR-, VR-, and paper-based scaffoldings could help the peers come into the features of collective scaffolding in the road of achieving HQC. In the current study, we used Hsieh's (2017) further classification of collective scaffolding who attempted to classify collective scaffolding into the three peer-to-peer scaffolding, multi-directional scaffolding, and individual scaffolding in a similar study on the role of online resources in a collaborative learning setting. That is why, we crystallized the interaction patterns of our three groups into these three scaffolding types and observed the behavior of each group through them.

4.2. Discussion

AR and VR scaffoldings in the present study provided us with a newer platform to explore how collaborating intermediate EFL students use AR and VR scaffoldings in building shared understandings in the meaning-making process in collective scaffolding. Adopting the synopsis of collective scaffolding by Hsieh (2017), this study probed how AR and VR scaffoldings can bring social creation of knowledge into surface. In line with Swain's (2010) *linguaging* on the role of language in knowledge construction, scaffoldings other than those by expert or peer have been used. This study included innovative closed technological scaffoldings in order to unravel the learners' collaboration in a computer-supported collaborative learning (CSCL) environment. In this meaning making process, the collaborating peers were supposed to work on abstract genre and the related sub-moves of Hyland's model of move analysis with support of AR and VR scaffoldings. As the transcripts for each major group of AR-, VR-, and paper-based scaffoldings reveal, the pairs in the AR group (N=42) had the highest language and abstract related transcripts compared with the other two major

groups of VR group (N=39) and paper-based group (N=38). The six features of collective scaffolding (Donato, 1994) were further classified into three scaffolding patterns in each group.

Hsieh (2017), knows an interaction excerpt as peer-to-peer scaffolding when one of the partners finds a slightly content from the provided scaffoldings and attempts to explain it to her peer in completing the concerned sub-move. He believes that three features of collective scaffoldings for Donato (1994) can be included in this category, namely: Collective co-construction, requesting assistance, and questioning competing forms. In other words, the provided scaffoldings (AR-, VR-, and paper-based scaffoldings) as a potential capacity can contribute one of the pairs assume the role of an expert and then transfer her findings to her partner. In this case, another peer can write the appropriate language. This other name for collective co-construction, requesting assistance, questioning competing forms, in fact, can make a stronger connection between the peers and help them learn with each other through division of labor. Thus this type of scaffolding between the peers was emerged by the provided resources as the mediation between them. The resources were the necessary and sufficient information which the peers needed in order to write an appropriate abstract genre sub-moves. This CSCL environment was fertilized with some closed technologies which could bring about fruitful results for the pairs.

For multi-directional scaffolding, Hsieh (2017) believes that multi-directional scaffolding is the time when both peers tend to help each other, despite that they do not have enough knowledge in the domain. That is why they both try to take the advantage of the provided resources and use it in their bidirectional interactions. In other words, technology resources play the role of a stimulus which supplies their collaboration in writing and then propel them to a common point in their dialogue in the meaning making process. The component jointly managing the components of the problem by Donato (1994) is included in this category. As a matter of fact, multi-directional scaffolding creates a triangle whose vertex is the resources and its other two angles are the two peers who try to collaboratively create knowledge feeding from the vertex in a shared understanding environment.

In individual scaffolding, the scaffolding revolves around the individual participant whose effort is to resolve her problem individually using the provided resources. Other- or self-correction by Donato (1994) can be enumerated in this scaffolding pattern in which the individual peer attempts to correct her mistake herself using the provided resources. Swain (2010) knows self-correction as the sign of learning language. Another feature in Donato's (1994) collective scaffolding as private speech can also be enumerated in this domain. In this feature the individual attempts to verbalize the concerned material in the resources in order to come into a more accurate

production. In fact, the technological scaffoldings play the role of an expert or more knowledgeable peer with whom the individual can "rehearse and gain control over their verbal behavior" (Donato, 1994, p.48). Although the name of this scaffolding pattern suggests, it is not an individual but an interactive discourse which happens collaboratively between the individual and the resources. Thus, a collaborative discourse emerges between them whose only indication in the writing document is the accurate use.

Although Donato (1994) and Hsieh (2017) have different classifications of collective scaffolding, they go through similar lines to achieve HQC in a meaning-making process. In other words, to unravel how collaborating partners can find shared understandings in their interactions, some collaborative discourse patterns happen. Donato (1994) calls such discourse as collective scaffolding with its six features which happens in a face to face interaction with one of the peers as an expert or knowledgeable to provide the necessary scaffoldings for the weaker peer and propel the interaction forward. However, Hsieh (2017) in a collaborative internet-enhanced face-to-face environment holistically abridges collective scaffoldings into three scaffolding patterns to reach HQC of Gutierrez's (2006). Hsieh (2017) calls this "Internet-Enhanced HQC" in which the peers can use the internet as the source with which the learners can construct their knowledge in a collective discourse, compared to Donato's scaffolding which only used the peers' background knowledge as the knowledgeable source.

Even though the previous studies regard different patterns for a collaborating discourse, the present study follows Hsieh's (2017) work in this field. Hsieh (2017) believes that the languaging used in this platform is to "convert online resources to scaffolding (peer-to peer scaffolding), elaborate online resources for mutual understandings (multi-directional scaffolding), and adopt online resources to improve language performance (individual scaffolding)" (p.13). The scaffolding resources provided for our three groups were the required chunks, lexical items, and tense for writing an abstract. These different resources could fertilize the peers interactions and in effect bring about more accurate and appropriate writing products. However, the different modes of resources used in each group could help collaborating peers differently come to a shared understanding and with different interactive patterns in knowledge construction.

The AR group with its most language and abstract related episodes was pioneer in using peer to peer scaffoldings of Hsieh (2017) in which the peers attempt to find the target form in the AR technology and use it to scaffold their partners in writing the concerned sub-move. The reason to use this type of collective scaffoldings can be traced to the nature of this technology which independent peers can take the advantage of the scaffoldings and then share it with their peers.

The VR group with its average number of language and abstract related episodes used multi-directional scaffolding more than the other two scaffolding patterns. In this type of scaffolding, Hsieh (2017) believes that both peers intend to elucidate the target content they got from the resources to facilitate the discussion among themselves. Involving both peers in this type of scaffolding to use the resources and then to share it among each other in writing the concerned sub-move was brought about by VR scaffolding group more than the other two groups. In fact, VR technology can provide more opportunities for the peers to consult with each other in resolving their writing difficulties. In other words, since the participants need to use their VR glasses in order to observe the target content, this can provide more time for the peers to discuss on the concerned issue and in effect create the triangle of resources and the two peers in multi-directional collective scaffolding. The emerged interaction pattern, thus, indicates the learners' full engagement with the provided peers in the writing task, including their partner and the VR resources. Here, the direction of the scaffolding is one way between the VR resources and the learners and two-way between the peers. This requires complete involvement of both learners since they need to engage not only with the provided VR scaffoldings but also with their peer in order to have more dynamic and proper language discussion in their meaning-making discussion.

For the third group which had the lowest number of language and abstract related episodes, the individual scaffolding pattern was more common among its participant. In this type of scaffolding pattern by Hsieh (2017), the individuals attempt to resolve their own performance problems by themselves using the provided paper-based resources content. In other words, paper-based scaffolding group had individual scaffoldings more than the other two types of scaffoldings. The individual in this group intended to correct themselves or their partners using the paper-based resources. Both peers performed independently, however, their interaction with the paper resources could put their interaction in the realm of collaborative discourse. Thus, the peers can come to conclusion by themselves with the prepared resources in order to correct themselves and their partners and improve their performance. The concepts inferred from individual scaffolding are autonomy and independent learning in which the individuals are at the center of the knowledge construction.

The three types of scaffolding patterns which were reflected in the AR-, VR-, and paper-based groups were further used to propel the peer interactions to a more accurate languaging and discussion in knowledge construction. Paving the way for language discussion is in line with many researchers (e.g., Bull et al., 1999; Stahl et al., 2006). The AR group could facilitate peer to peer interaction; the VR group could facilitate multi-directional scaffolding;

the paper-based group could facilitate individual scaffolding. This indicates that interaction pattern in collective scaffolding can be framed in different formats depending on the resources used. To put it simply, considering the related scaffolding patterns can better direct the practitioners to a more appropriate knowledge construction in the meaning-based environment. The languaging used in the meaning-making processes can enhance the learners' writing abstract moves. To note, it can be confessed that each of the peers involvement, peers and resources involvement, and individual involvement can be reinforced using specific technology or traditional paper-based resources. Thus, diagnosing the specific involvement for enhancing a skill in a specific field can be very illuminating in using the desired technology or traditional resources. AR and VR as the more modern technologies are more welcomed in reinforcing the languaging used in collaborative writing. These are aligned with what Littlewood (1996) declares in resorting to the learning strategies in increasing the learner autonomy. In fact, the provided scaffoldings can play a major role in enhancing autonomy. Although the integration of autonomy with collaboration is a demonstration of combining contradictions, it should be noted that each individual by himself or herself can promote this collaboration, that is autonomy in itself can fertilize a collaborative discourse and propel their language and discourse discussion.

5. Conclusions and Implications

The CSCL is an environment through which the learners can collaborate with each other with the help of an external technology. The collaborative discourse created can be among the peers and the technologies provided. The setting used in the current study was enabling the peers write a real abstract using dynamic scaffoldings of peers and technology. Hsieh's (2017) collective scaffolding in achieving HQC helped us in drawing a more accurate picture of interaction patterns among the peers. However, the AR scaffolding group demonstrated peer to peer scaffolding pattern; the VR scaffolding group demonstrated multi-directional pattern, the paper-based scaffolding group demonstrated individual scaffolding pattern. These three types of scaffoldings can be fruitful in different technologies used. Thus it is implicated that teachers can encourage learners to have different interaction patterns depending on the technologies used in their language and meaning-based collaborating tasks. Another noteworthy point, alongside the involvement these scaffolding patterns might bring about, is the assistance, co-construction, and accuracy each of them might provide. Therefore, another implication of this study is that practitioners as well as students can enhance assistance, co-construction, and accuracy in their knowledge construction and meaning-making discussions if they use peer-to-peer scaffolding, multi-directional scaffolding, and individual scaffolding, respectively. Thus, teachers and pedagogical parties are encouraged to use

AR learning resources in order to consolidate support and assistance among the learners and to use VR learning resources in order to reinforce shared construction among them. These two more recent technologies can not only elevate learners' autonomy in their language learning but can also help them learn collaboratively in a shared environment.

Although we believe our work could be a springboard for using new technologies in a collaborative environment, it has some limitations, as well. The most important limitation lies in the fact that diverse educational levels or different language proficiencies might have different scaffolding patterns than what we observed in this study. Furthermore, our small scale sample might also underestimate the complexity in the scaffolding pattern. Therefore, qualitative studies of a larger sample size encompassing more language and educational levels might enlarge our knowledge in this field.

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Bibliographic information of this paper for citing:

Soleimani, H., Jalilifar, A., Roohi, A., & Rahmanian, M. (2020). Augmented reality and virtual reality in a collective scaffolding platform: Abstract genre structure in a mobile-assisted language learning study. *Journal of Modern Research in English Language Studies*, 7(3), 1-22.
