# A case study of the dynamics of scaffolding among ESL learners and online resources in collaborative learning

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**ABSTRACT**

Collaborative learning has been widely applied in education, and has been seen as conducive to student learning. The advent of technology and its applications in education have also greatly enhanced the classroom learning environment, leading to increasing research attention on the combination of technology and collaboration. The case study discussed in this article explores collaborating learners' patterns of interaction in an Internet-enhanced, face-to-face collaborative setting by investigating learners' interactions with peers and online resources. Four graduate-level ESL learners (three Taiwanese and one Japanese) worked in pairs to write an essay with the support of online resources. The construct of high quality collaboration was used to examine learners' interaction patterns. Three distinctive scaffolding patterns among learners and online resources were identified: (1) peer-to-peer scaffolding, (2) multi-directional scaffolding, and (3) individual scaffolding. The findings suggest that online resources can facilitate critical scaffolding in learners' interaction and knowledge construction, which also encourages collaborative learner autonomy. The proficiency gap between collaborating learners was also observed to be alleviated through the support of online resources for the less proficient peers. This study sheds light on the role online resources can play in collaborative language learning.

**KEYWORDS**

Computer-supported collaborative learning (CSCL); online resources; scaffolding; interactions; learner autonomy

## Introduction

Since the 1980s, collaborative learning has been gaining in popularity (Brown, 2008) along with rising interest in Vygotsky's (1978) educational philosophy. According to Vygotsky's sociocultural the-ory of learning, knowledge is socially constructed through interactions with both mentors and peers. Collaboration offers a space in which such knowledge construction occurs as learners dialogically share, refine and elaborate information and ideas. Learners' interactive talk, termed as 'languaging' by Swain (2006, 2010), helps them make sense of their learning by making their understanding explicit to themselves. Languaging also mediates learners' higher order thinking and helps them gen-erate ideas to reach new understandings in a problem-solving process. As Golub (1988) claimed, 'it is in this talking that much of the learning occurs' (p. 20). Within the paradigm of sociocultural the-ory of learning, the notion of scaffolding is central. Scaffolding was initially defined as the assistance given by an expert/teacher to enable a novice/student to reach a higher level of performance than would otherwise be possible (Vygotsky, 1978; Wood, Bruner, & Ross, 1976), and was subsequently re-conceptualized to include the assistance shared among peers in the collaborative construction of learning (Bull et al., 1999; Crook, 1994; Donato, 1994). The construct of scaffolding was further

expanded with the advent of technology and its application in education, such as educational software (Gutiérrez, 2006; Lipponen & Lallimo, 2004; Mavrou, Leewis & Douglas, 2010) and Internet resources (Bruce, 1997; Hughes, 2013; Peters, Weinberg, Sarma, & Fankoff, 2011), creating a potentially powerful learning environment for collaborative learning. Among the technology applications, the role of Internet resources in learner interaction is the focus of this study. In a traditional collaborative learning activity, peers and teachers are the source of scaffolding, but in an Internet-enhanced collaborative learning environment, the sources of scaffolding are greatly expanded to include a wide range of online resources, through which learners can get assistance (Brush & Saye, 2001; Land & Hannafin, 2000; Bull et al., 1999). In such an environment, Hannafin and Land (1997) stated, '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). This observation can be extended to collaborative reflection as well.

During the last two decades, in response to the trend of integrating computer programs and features into collaborative work, the research area of computer-supported collaborative learning (CSCL) has emerged and generated a rapidly growing number of studies to explore how people learn together with the help of computers (Bull et al., 1999; Roschelle, 1996; Koschmann, 2002; Stahl, Koschmann, & Suthers, 2006; Suthers, 2005a, 2006). Researchers have investigated ways in which meaning-making processes and learning occur through technology-enhanced interactions among learners in both online collaborative settings (Kessler, Bikowski & Boggs, 2012; Lee, 2010; Li & Zhu, 2013; Zeng & Takatsuka, 2009; Zorko, 2009) and face-to-face collaborative settings (Crook, 1994; Gutiérrez, 2006; Lipponen & Lallimo, 2004; Mavrou, Leewis & Douglas, 2010; Roschelle, 1996; Stahl, 2004; Suthers, 2005a, 2005b; Wegerif & Mercer, 1996; Zurita & Nussbaum, 2007). Among those studies, both peer-to-peer scaffolding and the abundant technology resources are acknowledged to have substantially expanded learning environment. Researchers have investigated how learners interact with technology features (e.g. Wikis, web search tools, search engines, etc.) (Kessler et al, 2012; Stahl, Koschmann and Suthers, 2006) and software (Lipponen & Lallimo, 2004). However, limited research attention was specifically dedicated to how learners interact with online resources in language learning face-to-face interactions. Online resources in this study are defined as all resources available online that might help students' language learning, such as dictionaries and edu-cational websites. This case study intends to address this gap by exploring the way collaborating learners interact with online resources and each other to create shared understandings in the mean-ing-making processes. To understand the discourse among learners collaborating face-to-face that contributes to the building of shared understandings, past studies in language learning collaboration and learner interaction in CSCL context are reviewed in the following section.

### *Language learning collaboration*

A wide range of studies have investigated how language learners provide mutual scaffolding in a face-to-face collaborative setting to enhance each learner's progress in their zone of proximal development (ZPD), conceptualized by Vygotsky (1978) as the continuum between a learner's present level and his/her potential level of learning attainable with the support of others. Applying Vygotsky's notion to language learning, Ohta (2001) has described 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). Researchers found that the discourse among collaborative learners that could help them work in their ZPD and create shared understandings include the following: collective co-construction (the incorporation of an utterance produced by another peer and one's own utterance), explicit requests for assistance, questioning competing forms, jointly managing components of the problem, other-or self-correction, and private speech triggered by interactional conversation (Foster & Ohta, 2005; de Guerrero and Villamil, 2000; Donato, 1988, 1994; Ohta, 1995, 2001), termed as *collective*

*scaffolding* by Donato (1994). Foster and Ohta (2005) also identified several collaborative discourse patterns that paralleled Donato's findings, including co-construction, incorporation of language, other-correction, and self-correction.

In addition to collective scaffolding, research shows that learners in collaborative writing tasks also display collaborative discourse that supports their joint writing tasks. De Guerrero and Villamil (2000) indicated that learners support their joint work with 'scaffolding mechanism' (p. 64) through various behaviours, such as mutual engagement, discussions on differing opinions, explanation, modelling, contingent use of L1, and the establishment of shard focus and intention. Swain and Lapkin (1998), examining peer interactions during writing processes, observed that learners produced collaborative dialogue through language-related episodes (LREs), in which learners 'talk about the language they are producing, question their language use, or correct themselves or others' (p. 326). With such collaborative dialogue, learners are able to pool their knowledge to scaffold each other, build linguistic knowledge, and achieve shared-understanding (Donato, 1994; Ohta, 2001, 2005; Swain & Lapkin, 1998). This aligns with Storch's (2005) findings indicating that the most valued aspect of collaboration by learners is the opportunity for them to generate ideas together and to be exposed to different views when approaching a writing task.

### *Learner interaction and scaffolding in CSCL*

The field of CSCL is characterized by Koschmann (2002) as the study of meaning-making interaction in the context of joint activity mediated through technologies. CSCL researchers have suggested that affordances of technology can serve as mediational tools to create shared understandings for learners in different learning modes including online written interactions (Bradley, Lindström, & Rystedt, 2010; Kessler, Bikowski, & Boggs, 2012; Li & Zhu, 2013; Zeng & Takatsuka, 2009; Zorko, 2009), online oral interactions (Cziko & Park, 2003; Jepson, 2005; Lamy, 2004; Yanguas, 2010) and face-to-face interactions (Gutiérrez, 2006; Lipponen & Lallimo, 2004; Lund, 2008; Mavrou, Leewis, & Douglas, 2010; Zurita & Nussbaum, 2007). For example, Li and Zhu (2013) analysed language learners' interactions in an online forum during a wiki-mediated collaborative writing task and found that wikis' affordances supported collaborative learners' formation of shared knowledge and engaged them in the revision process; Kessler et al. (2012) reported that Web-based word processing tool facilitates online collaborating writers to assist each other through collective scaffolding in the revision process. Yanguas (2010), examining the role of oral computer-mediated communication (OCMC), found that OCMC, especially video conferencing, offers similar advantages of the traditional face-to-face learning mode by looking into the turn-taking patterns between L2 learners.

As for face-to-face interactions, Lipponen and Lallimo (2004) reviewed a wide range of educational software for face-to-face collaboration and acknowledged that the software provide scaffolding that engage collaborating peers in complex cognitive activity with varied types of notification cues (e.g. graphics and motion). Mavrou et al. (2010) also acknowledged that the presence of such cues encourages learners' language discussions and helping behaviours. In the same vein, Gutiérrez (2006) compared Spanish learners' progress through collaborative activity with computer software built-in aids such as clues and hints, and with paper-based tasks. She identified a larger number of instances of high quality collaboration (HQC), defined as 'collaboration where learners, working within a ZPD, are able to co-construct language related knowledge' (p. 238), in computer-supported tasks than in paper-based tasks. The design of collaborative-oriented digital system, such as a shared display screen that shows collaborating learners' individual and integrated work during a joint task, also manifests its efficacy in facilitating face-to-face interaction and supporting group discussion (Zurita & Nussbaum, 2007). Such shared screen could promote mutual interactions and communi-cation, contributing to more effective shared knowledge construction in collaborations (Nussbaum et al., 2009; Chung, Leet, & Liut, 2013). Thus, the embedded scaffolds in educational software as well as the infrastructure of collaborative-oriented digital systems have the potential to support so-called *collective scaffolding* (Donato, 1994), the discourse that helps to create shared understandings

among collaborating learners. Learners could interact with the available scaffolds (e.g. cues, hints, and graphics) and features of digital systems (e.g. being able to see the integrated work) to support their mutual discussions and promote interactions.

Besides the abovementioned scaffolds, learners also benefit from interacting with online resources to support their collaborative meaning-making processes (collaborative web search) (Stahl et al. 2006). Research in collaborative web search has investigated learners' interaction patterns with the mechanic aspect of web search – the design of digital system (e.g. multi-cursor functionality, interactive tabletop display, division of webpages, and diverse search engines) – and how the features affect their search practices (Amershi & Morris, 2008; Maekawa, Hara, & Nishio, 2006; Morris, Paepcke, & Winograd, 2006; Morris & Horvitz, 2007) and cultivate their search literacy (Pegrum, 2011). However, few looked into learners' interaction with the content aspect of web search – the diversity of online resources – and how the use of online resources supports their meaning-making processes. The use of online resources has been widely acknowledged for its benefits and scaffolding in helping language learners to construct knowledge (Hughes, 2013; Marchionini, 2006; Suthers, 2005a). While researchers have noted that the diversity of online information multiplies learning and practice opportunities for language learners (Bruce, 1997; Hughes, 2013; Peters, Weinberg, Sarma, & Fankoff, 2011), most research has focused on individual rather than collaborative learning context for the benefits of online resources. Thus, it is not clear how collaborating learners use online resources to support the development of shared understandings, leaving open a niche for further inquiry. This study explores how learners collaborating face-to-face interact with online resources in support of the meaning-making processes. Following Gutiérrez (2006), this study adopts a sociocultural perspective, using the notion of HQC to analyse learners' dialogue when they collaborate with peers while using online resources. HQC can be achieved through collective scaffolding (Donato, 1994); hence, the construct of collective scaffolding was used to identify the dynamics of scaffolding among learners and online resources in the meaning-making process. The core enquiry in this study is: through the lens of collective scaffolding, how do collaborating language learners use online resources to build shared understandings in the meaning-making processes?

## Research design

This case study was conducted in a major Midwestern research university in the United States. Four graduate-level international students participated in the study. Due to its in-depth nature, the study only recruited a small sample size. Learners' interaction with online resources and peers was explored as they engaged in a collaborative writing activity in a face-to-face setting. The collabora-tive writing task was particularly designed for this study, hence was not part of their regular curricu-lum. The researcher was not the instructor in their respective programs, thus there should be limited concern about potential bias and conflict of interest over the study. In the writing task, par-ticipants collaborated in pairs to construct a short text (approximately 150 words) in English to introduce 'The Amish Culture,' chosen because of the close proximity of an Amish village to the uni-versity. This meant that the writing experience could serve as an integral part of their cultural explo-rations in the United States. The 150-word length was adopted from Taiwan Language Testing Center's suggested essay length for the General English Proficiency Test, a nationwide language test in Taiwan. They each used their own laptops to co-construct the text to avoid one participant domi-nating the writing process. To enable shared document creation and real-time co-editing, this study employed one of the wiki tools, PBworks, as the participants' shared writing space. Previous litera-ture has indicated that wikis provide affordances that scaffold collaborative writing such as the shared space for information sharing, co-editing and text co-construction (Richardson, 2009; Woo, Chu, Ho, & Li, 2011). Participants constructed and edited their writing in the shared wiki page using their personal computers. Users can also insert non-textual content (videos and images) in the text to their shared document, allowing them to present their text in a multimodal manner. The user friendliness of PBworks (Zorko, 2009) was another reason why it was chosen as the writing platform

in this study. Since the main goal of this study is to examine the way the participants interact with online resources to construct knowledge instead of the products of this collaboration, the primary data set is the observations of the participants' interactions rather than the final writing product in PBworks. After the writing task, the researcher conducted a post-task interview with each pair as a point of reference for drawing inferences about the participants' intentions during their interactions.

### *Participants*

The participants were four graduate-level ESL learners (three Taiwanese and one Japanese) studying at a major Midwestern research university in the United States. This case study focuses research attention on an in-depth analysis of learner interactions; hence only a small number of participants were recruited (see also Donato, 1994). The researcher sent out participant recruiting emails to the Taiwanese Student Association and the Intensive English Program (IEP) at the university, where the researcher had the most access to English L2 learners. Among the students who agreed to participate, the researcher shortlisted four students who had all stayed in the United States for a similar period of time and had different levels of iBT TOEFL scores representing different levels of language proficiency. Table 1 summarizes their demographic information, their TOEFL scores, time spent in the United States, online activities they performed on a daily basis, and previous collaborative experiences. All names are pseudonyms. Lily and Ed were master's degree students in the music department, and Hannah and Carol were in the IEP ready to apply for graduate programs. Based on their TOEFL iBT scores, Lily, who scored 85 out of 120 and Hannah, who scored 79, were categorized at the intermediate level. Ed, who scored 92, was at the intermediate to advanced level, and Carol, who scored 103, was at the advanced level (ETS, n.d.). They had all been in the United States for one to two years. Lily and Ed both came to the United States from Taiwan for graduate studies in music. Lily arrived in the United States one semester earlier than Ed to attend language learning courses offered in a community college before she entered university; both of them were in their second year of studies when they participated. Carol, also Taiwanese, and Hannah, a Japanese, both came to the United States for the IEP offered in the university before they applied for graduate programs. Hannah intended to study economics and Carol wanted to apply for business school. They had almost completed their IEP at the time of this study.

In addition, understanding their habit and ability to locate and use information online was critical for this study since online resources were an integral part of their collaboration process. Carol spent the most time on Internet activities per day (more than eight hours), while Hannah the least (two hours). Lily and Ed spent comparable amount of time online per day (four hours). It shows that all four participants had the habit of using online tools or resources in their daily lives. As indi-cated by the participants, the online activities included the use of social networking tools (e.g. Skype and Facebook), communication tools (e.g. email), informational websites (e.g. Wikipedia), lan-guage-learning tools/websites (e.g. online dictionaries, Google translate, thesaurus dictionaries, and CNN.com), recreational websites (e.g. YouTube), and profession-specific websites (e.g. music-related websites). Despite the difference in the time they spent online, all four participants indicated their frequent use of the various online resources mentioned above, especially language-learning tools and websites, reflecting their ability to use various online resources. As for collaborative

**Table 1.** Participants' demographic information.

| Pair | Name | Nationality | Major | Age | iBT TOEFL score | Time in the United States | Time spent on the Internet (per day) |
|---|---|---|---|---|---|---|---|
| 1 | Lily | Taiwanese | Music | 23 | 85 | Two years | Four hours |
| | Ed | Taiwanese | Music | 30 | 92 | 1.5 years | Four hours |
| 2 | Hannah | Japanese | IEP level 4[a] | 23 | 79 | One year | Two hours |
| | Carol | Taiwanese | IEP level 7 | 26 | 103 | One year | Eight+ hours |

[a] The IEP program places students from level one (the lowest) to level seven (the highest).

experiences, all four participants had had collaborative learning experiences in their high school and undergraduate studies and expressed positive attitude towards it. However, they never had collabora-tive writing experience in a face-to-face setting with the support of online resources. For the pairing arrangement, this study followed previous studies exploring learner interaction patterns (Gutiérrez, 2006; Lin & Maarof, 2013; Storch, 2002; Suthers, 2005a) and adopted self-selected pairing arrange-ment based on their familiarity with each other. This allowed learners to work together in a natural way than assigned pairing. Lily worked with Ed (pair 1) and Hannah worked with Carol (pair 2).

### *Data collection*

The primary data set in this study were the audio and video recordings of learners' interactions during the writing process and the post-task interview with each pair. Table 2 summarizes the data collection procedure of the study. The two participants in each pair worked face-to-face at the same time in the same place. The task was conducted in an empty classroom to ensure the quality of their voice recording. Due to their different schedules, the two pairs carried out the task at different times.

At the beginning, a short survey was administered for the researcher to collect the participants' demographic information, English proficiency, time spent in the States, and the online activities they performed in both educational and informal contexts. The survey helped the researcher to keep a written record of the participants' information, and it was followed by an interview, where the researcher asked for further information and elaboration based on the survey responses. Prior to the actual writing task, preparatory work including a PBworks tutorial and an introduction of the collaborative work was carried out. The researcher gave a brief tutorial about the features and functions of PBworks in order to familiarize the participants with their writing environment. The tutorial included creating a shared wiki page, co-editing the same document, sharing information (by pasting the content to the shared wiki page so that their peer can see the content from their screen), and inserting non-textual content into the text. The participants were then given time to set up their writing environment in PBworks. One of the two learners created an account and invited the other to be the editor, so they could edit and construct the text simultaneously using their own computers. The researcher then confirmed the participants' understanding and ability to perform those basic functions with a 15 to 20-minute practice. According to Kim and McDonough (2008), it is essential to introduce the practice of collaborative learning and to give instructions before learners begin their task. In this study, the participants never had such collaborative writing experiences before, so after the tutorial and practice, the researcher initiated this brief discussion. The researcher also modelled ways in which they could give each other assistance to encourage their mutual interaction and assistance, such as explaining, confirming each other's understanding, referring to information online to help each other, and resolving linguistic difficulties together.

The actual writing task began after the preparatory work. The participants could access any online resources to help them generate ideas, collect information, and overcome language difficulties during the writing process. To discourage learners from copying and pasting a whole passage of online text into their writing, the learners were strongly encouraged to use their own words to con-struct their texts. This would encourage them to discuss and brainstorm how to rephrase an idea.

**Table 2.** Data collection procedure.

| | | Data collected |
|---|---|---|
| Tasks | (1) Short survey | Demographic information, English proficiency, time spent in the United States, online activities they performed, collaborative experiences |
| | (2) Preparatory work<br>• PBworks tutorial and practice<br>• Introduction/modelling of collaborative interaction | |
| | (3) Collaborative writing | Audio/video recordings of interaction patterns |
| | (4) Stimulated recall interview with each pair | Participants' responses to the researcher's inquiries about specific scenarios |

Examples of summaries, paraphrases and plagiarism were given and illustrated to ensure the participants' clear understanding of 'using their own words.' The participants adhered to this rule mostly, although they did use some phrases or words from the online articles. They worked for approximately one hour on the task. The whole collaboration process was audio and video recorded. When they had completed the task, they participated in a 20-minute stimulated-recall interview, in which the video-recording was stimuli for the participants to recall a particular moment while carrying out the task. The participants viewed particular moments chosen by the researcher and answered questions about their thinking processes and intentions during those moments. Sample questions included: 'When he/she asked for help, how did you think you could help him/her?', 'In what way do you think the online information helped (or did not help) you when you constructed this sentence?', or 'What made you change the word use?'. The interview data were used to supplement researcher's interpretation of the participants' thinking processes as they interacted with online resources. The whole procedure took approximately two hours to complete for each pair.

### *Data analysis*

The notion of HQC was adopted to identify the dynamics of scaffolding among learners and online resources in the meaning-making processes. Data analysis followed three steps as follows.

1. Transcribing: the two pairs' oral interactions were transcribed, and a second reviewer checked the transcripts with the recordings to confirm their accuracy. The video recordings allowed the researcher to note down learners' contextual/behavioural information (e.g. writing, check-ing online, studying the information on the computer screen, pointing to the screen display, etc.), as suggested by previous studies that visual focus gestures such as hand-pointing can be indicative of interactive discourse (Chung, Leet, & Liut, 2013; Erickson & Kellogg, 2000). In data excerpts, contextual information is presented in brackets.
2. Identifying LREs: since this study focused on learners' discussions on language-related knowledge, the construct of LREs (Swain & Lapkin, 1998) was used to identify any part of the dialogue in which learners talk about the language they are producing. The researcher then categorized the LREs into Internet-assisted LREs and non-Internet-assisted LREs. Internet-assisted LREs were any segment of conversation that was completed, enriched, or facilitated by online information (e.g. underlined segment in Excerpt 1). On the contrary, non-Internet-assisted LREs were those not influenced by the use of online resources. Another independent coder performed the categorization based on the same criteria, and any disagreement was discussed till a consensus was reached. The inter-rater reliability obtained in the identification and categorization of LREs was hence 100%. For the purpose of this study, the research analysis focused on the Internet-assisted LREs.

Excerpt 1: example of the Internet-assisted LREs

| | |
|---|---|
| L: | … .And their wearing is different. They are wearing… |
| K: | Their own traditional costumes. |
| L: | Yes, yes. |
| K: | [Searching online] Okay I saw it. They call it 'plain dress.' Plain, very plain. |

3. Examining through collective scaffolding: collective scaffolding was used as a lens to examine how learners interacted with peers and online resources to achieve HQC. Each Internet-assisted LRE was examined using the six features of collective scaffolding to see how Internet resources came into play in each feature: collective co-construction, explicit requests for assistance, questioning competing forms, jointly managing components of the problem, other- or self-correction, and private speech.

The findings of learners' interaction while using online resources to reach shared understandings are presented in the following section.

## Results

Across the two pairs, 21 LREs were identified, among which 13 were categorized as Internet-assisted LREs and 8 as non-Internet-assisted ones. These 13 LREs were further categorized into the six features of collective scaffolding. The following excerpts from the two pairs' interactions illustrate how online resources played a role in each feature among the Internet-assisted LREs.

### *Collective co-construction*

Excerpt 2 demonstrates collaborative completion, in which one learner completes another learner's unfinished utterance.

Excerpt 2: example of collective co-construction

| | | |
|---|---|---|
| 22 | Lily: | I heard that Amish people don't use electronic and those device. I think they are really… .really… um… . |
| 23 | Ed: | [Checking online] Conservative? |
| 24 | Lily: | Yes, yes. |
| 25 | Ed: | That's also what I see how they [pointing to online article] describe them. |

Lily tried to describe Amish people's lifestyle but experienced difficulty (line 22). Ed spotted the word 'conservative' from an online article describing Amish people's lifestyle and helped her complete the sentence (line 23) when she had difficulty verbalizing her ideas. Lily's reply 'yes' (line 24) signalled her recall of the word and acknowledgment of Ed as a co-constructer. Online resources assisted Ed directly, by allowing him to confirm the appropriateness of the word to describe their lifestyle, and Lily indirectly, by receiving help from Ed. HQC was achieved with the co-construction of language-related knowledge. Such sentence completion, also acknowledged in Storch's (2002) study as 'cohesion,' is an important pattern of engagement while doing a task. When situated in an Internet-enhanced setting, computers become an integral part of such engagement.

### *Requesting assistance*

Excerpt 3 illustrates an example in which learners' implicit request was assisted with the help of online resources.

Excerpt 3: example of requesting assistance

| | | |
|---|---|---|
| 30 | Hannah: | My English is getting worse. I cannot construct a sentence… . |
| 31 | Carol: | It's fine. [Searching for information. Showing a picture to Hannah] They all live with old fashion, right? |
| 32 | Hannah: | Yeah. |
| 33 | Carol: | [Reading an online article] And they live without electricity, or advanced technology. |
| 34 | Hannah: | Okay, okay. [Writing] |

Hannah expressed lack of confidence in her English writing skills (line 30). In response to her implicit request for assistance, Carol consulted online resources, showed Hannah an image of a carriage with Amish people in it (Figure 1), and suggested a possible way to describe it (line 31). Carol then read to Hannah a sentence from an article (line 33) to provide some ideas for writing. Carol mentioned:

> I thought…I could help her by firstly show her some images of Amish people…at least to let her see something. And I guess I need to suggest her possible ways to describe what she sees…so I said *old fashion* and I read some words from the article [… .] Yeah I think online resources gave me some ideas to help Hannah [… .].

**Figure 1.** Amish carriage.

In this episode, Hannah's implicit request for assistance elicited Carol's scaffolding, which was greatly complemented by visual and textual online resources. Carol's reflections in the interview confirmed the researcher's observation that the availability of rich online information greatly assisted her in helping her partner.

### *Questioning competing forms*

Linguistic development is engendered through the process of questioning the use of language (Donato, 1994). This is exemplified in excerpt 4.

Excerpt 4: example of questioning competing forms

| | | |
|---|---|---|
| 86 | Hannah: | 'Amish?' [Looking at computer screen] It said 'the Amish.'<br>I think we need 'the Amish.' [Pointing to the screen] It's not 'Amish.' |
| 87 | Carol: | [Studying online information] Oh I see. |
| 88 | Hannah: | It's grammatical. |

Hannah questioned Carol's use of language in terms of the article 'the' before a specific group of people (line 86). She resorted to an online article for verification, suggesting the correct form 'the Amish' (line 86), which helped Carol to learn the correct grammatical form after studying the online information (line 87). In such scenarios, online resources came into play in the choice between competing forms and helped learners make accurate lexical/grammatical decisions. Hannah explained:

> I think we may need *the* in front of Amish people…but I am not sure…so I check the online article to make sure this is the right use. Yeah and when I confirmed that, I told Carol we need *the* before Amish….

The scaffolding enabled Hannah, despite being the less proficient peer, to help Carol, reach a higher degree of language accuracy. Hannah's responses in the interview matched the researcher's inference that, with the support of online information, she had higher degree of confidence when she challenged her partner on language use.

### *Jointly managing components of the problem*

Jointly managing components of a problem occurs when each peer contributes their background knowledge or information they found online to complete a joint task. Excerpt 5 shows how Ed's and Lily's knowledge converged as they interacted with online resources to try to figure out the meaning of 'baptism.' The parts where learners interacted with online resources are underlined.

Excerpt 5: example of jointly managing components of the problem

| | | |
|---|---|---|
| 50 | Ed: | Do you know what is 'baptism?' |
| 51 | Lily: | Nope. [Searching online] Is that a service in their religion? |
| 52 | Ed: | [Searching online]…I think it's a kind of ceremony…well not ceremony.. |
| 53 | Lily: | Service? |
| 54 | Ed: | But not regular service, right? |
| 55 | Lily: | It's not ceremony right? |
| 56 | Ed: | No because ceremony is to celebrate something. |
| 57 | Lily: | Yeah I know what you mean. |
| 58 | Ed: | [Searching online] I saw 'infant baptism.' |
| 59 | Lily: | Is that for infant? |
| 60 | Ed: | Not only for infant, but some.. |
| 61 | Lily: | Yes, cuz I saw the picture. I don't think it's infant…that's so big.. I find a picture for Amish girl [Showing the screen to Ed],. |
| 62 | Ed: | Wiki says Amish church members begins baptism usually between age 16 and 25. This is a requirement for marriage. |
| 63 | Lily: | This is a requirement before marriage or after? Is it like every Amish have to do or they can choose they want to do or not? Is it..is it optional ..or not? |

[Conversation continued]

In lines 51 and 52, a Google search helped Lily and Ed construct their initial assumptions about the unknown word 'baptism' as 'religious service' and 'ceremony.' Their deliberations continued until later Ed visited a tourist website where he found discussions on infant baptism (line 58). The embedded links in this website led Ed to Wikipedia, where he found more information about the age of baptism in Amish societies (line 62). Lily, on the other hand, resorted to visual aids (image of an Amish girl being baptized) to try to understand this term. Lily indicated that, 'I like to use images to help me understand something…because I don't like to read a lot of text [….] so I Google searched it and saw images that helped me understand….' The information they found such as images and explanation of the ceremonial aspects of Amish baptism (age, requirement for marriage) was incorporated into their conversation, allowing them to elaborate on their understanding of 'baptism.' Ideas evolved as more information was obtained and shared, as Ed mentioned, 'yeah the more I read the more I understand what that is and the more I know how to describe it [….].' As the learners were empowered by online resources to contribute and synthesize ideas, they constructed and consolidated the meaning of the term 'baptism.' In this episode, we see that the Internet search system allows learners to access multiple relevant websites and conduct cross-references to complement their findings from different resources. Furthermore, the embedded links in the texts that bring learners to other related resources provide learners with more comprehensive understanding and hence greatly assist learners' exploratory search on an enquiry.

### *Other- or self-correction*

Excerpt 6 is an example of self-initiated correction, in which learners detected their own mistake and corrected themselves immediately.

Excerpt 6: example of self-correction

| | | |
|---|---|---|
| 79 | Carol: | Yes. Oh, because they were in Switzerland, so in 18th century they moved to…some Amish people moved… [looked at the screen]…immigrated to America. And at the beginning they located, they were located in Pennsylvania, then they moved to Illinois, Indiana and other places. |

Carol was explaining Amish people's immigration history to Hannah. Initially she said they 'moved,' but immediately after checking the Wikipedia, she changed the verb to 'immigrated' (single underlined part). Carol mentioned in the interview that 'I am so used to using *move*… but I saw the word *immigrate*…then I remember this is a better word to describe people moving to another country….so I changed it.' Here online information served as a model for learners to compare and reflect on their language use so as to produce accurate/proper language. It is also interesting to note that she did use 'moved' (double underlined) to describe the people's relocation within the country, indicating that she understood the distinction between the two verbs.

### *Private speech*

Private speech was described by Vygotsky (1986) as a child's speech to himself stimulated by social interactions and experiences. Such self-directed utterances regulate one's mental processes in order to approach a task that may be beyond one's present competence but can be completed with scaffolding. In this study, private speech was not triggered by human interactions but by online resources, which is also part of the social interaction context. In excerpt 7, Lily performed private speech while watching a video about Amish culture.

Excerpt 7: example of private speech
[Lily was watching a video about Amish culture]

| | | |
|---|---|---|
| 35 | Video: | The largest settlements are in Pennsylvania, Ohio and Indiana… |
| 36 | Lily: | Pennsylvania, Ohio and Indiana [Repeated after the video]. The Amish people… [Mimicking the tone in the video. Kept listening] |

[Lily continued performing private speech]

She mimicked how the names of three US states were pronounced in the video, and then she followed the intonation with which 'Amish people' was pronounced (line 36). The video provided a pronunciation and intonation model for Lily to follow, allowing her to reach a higher degree of oral accuracy. 'I just think that those words were pronounced with beautiful tones…I want to learn the tone so that I can be more accurate…,' Lily believed that by practicing with the video clips repeatedly, she could pronounce those words and phrases in a more 'native' way. These excerpts illustrate how collective scaffolding was achieved through the interaction among learners and online resources to support HQC. The nature of the interaction patterns is further discussed in the following section.

## Discussion

Through the lens of collective scaffolding, this study explored the role online resources played in a collaborative learning setting. The Internet-learner interactions were further summarized as three distinctive scaffolding patterns: peer-to-peer scaffolding, multi-directional scaffolding, and individual scaffolding. They are discussed in the following section.

### *Three distinctive scaffolding patterns*

#### *Peer-to-peer scaffolding*

In peer-to-peer scaffolding, one peer obtained scaffolding from online resources and used it to help the other peer, as shown in Figure 2. Excerpts 2, 3, and 4 are examples of this type of scaffolding, in which online resources played the role of an expert by providing scaffolding in a way that empowered one learner to scaffold the other toward correct language use. This type of scaffolding pattern reinforces the development of peer assistance. As shown in excerpt 4, the Internet-enhanced scaffolding empowered the less proficient (Hannah) peer to assist the higher proficient peer (Carol), which seemed to mediate the gap in language competence between them. The enhanced peer-to-

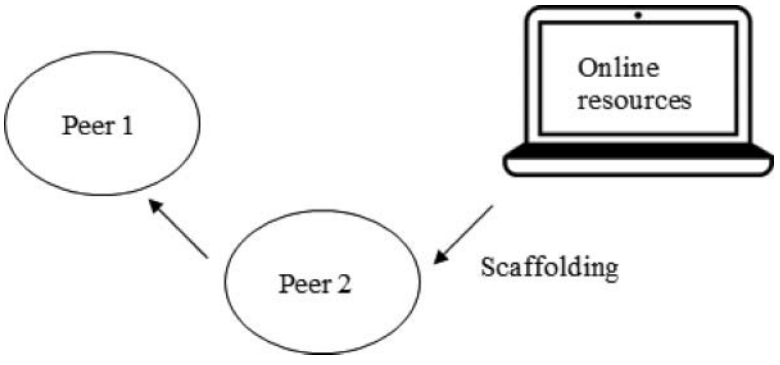


**Figure 2.** Peer-to-peer scaffolding.

peer scaffolding reflected the role of technologies as a meditational tool mentioned in many CSCL studies. Unlike educational software that provided a fixed set of notification cues to scaffold learners, online resources allowed learners to access diverse information that best accommodated their needs to give each other proper scaffolding (e.g. Carol using visuals to help Hannah).

### *Multi-directional scaffolding*

In the multi-directional scaffolding, both learners obtained scaffolding from the online resources to support their mutual assistance and interaction as they engaged in the meaning-making process. This type of scaffolding pattern reinforces the co-construction of shared understanding. Excerpt 5, in which Ed and Lily jointly approached the term 'baptism,' shows the convergence of the knowledge they obtained from online resources and emergence of a shared understanding. The rich online information enabled learners' conversation to grow more elaborated toward knowledge construction. The bi-directional scaffolding between two peers in a traditional face-to-face interaction was expanded to multi-directional scaffolding among online resources and peers in the Internet-supported context (see Figure 3), sustaining the dynamics of interactions between the two peers.

### *Individual scaffolding*

Individual scaffolding occurs between an individual learner and the online resources (see Figure 4). In excerpt 6, Carol used online resources as scaffolding to initiate self-correction. Such self-corrections represent language learning in progress, making them a potential site of language learning in collaboration (Swain, 2010; Swain & Lapkin, 1998). Another example is excerpt 7, in which Lily imitated the model language production online to reach a higher performance. This reflected Donato's

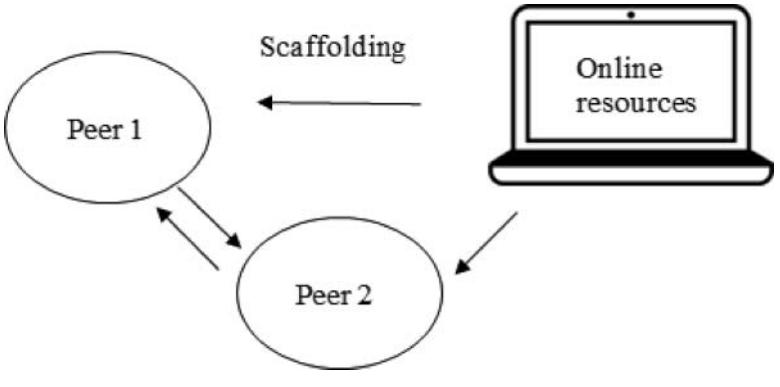


**Figure 3.** Multi-directional scaffolding.


**Figure 4.** Individual scaffolding.

(1994) notion of private talk as a tool for learners to 'rehearse and gain control over their verbal behavior' (p. 48), allowing subsequent efficient communication among learners. While self-correction and private speech are usually stimulated by human interactions in collaborative settings, in this study, they are triggered by online resources, an integral part of the collaboration as a 'peer.' Therefore, following Donato (1994) and Storch (2013), this study includes the two acts as 'collaborative discourse' since they are also products of social interactions. While knowledge construction might not be overtly observable in peer dialogues in this type of scaffolding pattern, it could be inferred from the higher degree of their accuracy in language production.

Figure 5 illustrated the realization of HQC through the three Internet-integrated scaffolding patterns. The three types of scaffolding have expanded the notion of HQC in Gutiérrez's (2006) study, in which learners' background knowledge is the only source for their collective scaffolding, to an Internet-enhanced HQC, in which alternative sources are available to supplement learners' background knowledge and thus to facilitate their meaning-making processes.

Previous research has recognized that when learners collaborating face-to-face engage in languaging, they go through cognitive processes that involve initiating self- or other-corrections, debating their ideas, exploring alternative language choices, looking for ways of expressing ideas, explaining grammatical rules, and asking and receiving help (Storch, 2013; Swain 2006, 2010). It is noteworthy that, besides these discourse, learners in this study are also involved in additional cognitive processes with languaging. These include using languaging 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). The discussion of the nature of the scaffolding patterns can be complemented with a further exploration into the scope of online scaffolding in learners' language discussions. This is discussed in the following section.

### *The scope of online scaffolding in language discussion and learner autonomy*

Learners' strategic use of a variety of online resources, primarily various functions of online dictionaries (e.g. pronunciation, definition, and sample sentence), Wikipedia, informational and tourism websites, allowed them to broaden their discussions to cover a wide range of aspects of language use including lexical choices, grammar, sentence construction, modelling, and understanding unknown terms. Situated in such Internet-enhanced context, learners' 'languaging' (Swain, 2010), or LREs (Swain & Lapkin, 1998), was further facilitated by online information that mediated their discussions and helped them resolve language difficulties. The extensive scope of learners' language discussion reflected the notion that online resources has the potential to open a ground for discussion among collaborating learners (Bull et al., 1999; Stahl et al., 2006; Suthers, 2005a), supporting learners' brainstorming, the most valued aspect of collaboration by learners (Storch, 2005). Therefore, the dynamics and the scope of the scaffolding among learners and online resources allow us to conceptualize the role of computers as a 'peer' rather than a 'tool,' which interacts with learners and facilitates their specific meaning-making and knowledge construction processes.

The enhanced 'languaging' that results also has a role in mediating the peers' language profi-cienc gap. Previous research indicated that lower proficient peers tend to feel intimidated and

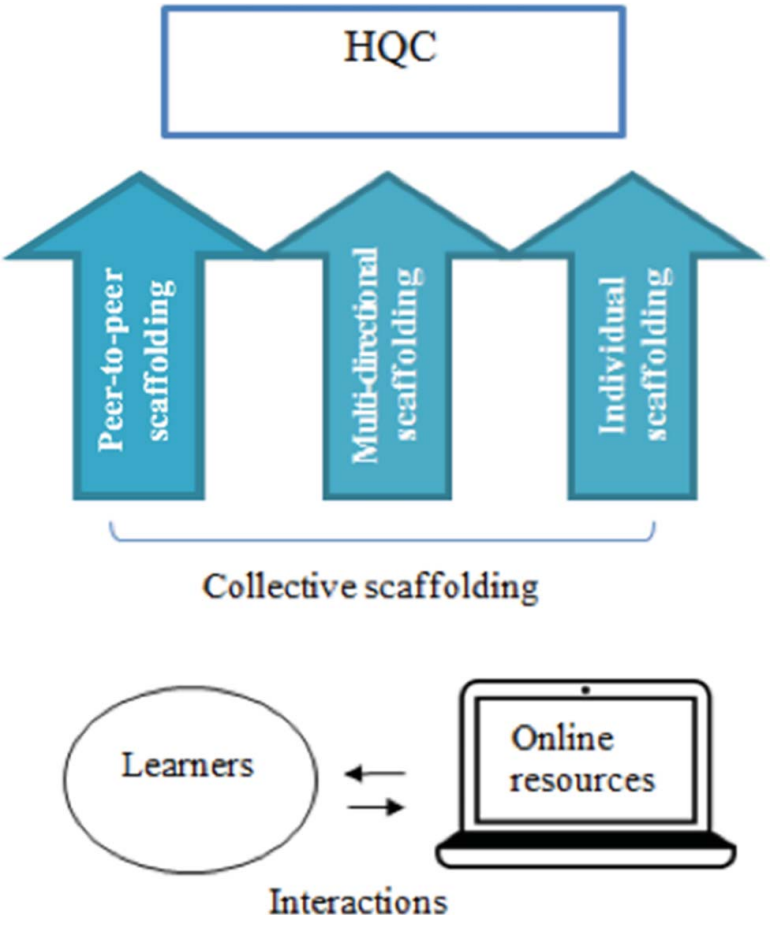


**Figure 5.** The realization of HQC through three scaffolding patterns in the Internet-enhanced collaboration setting.

remain passive when teamed up with a higher proficient peer in pair work (Swain & Miccolli, 1994). However, this study suggests that less proficient peers could also make meaningful contributions with the help of Internet resources, which may alleviate the negative feeling in such paring. The diverse interactions with various online resources also highlight the value of the function of Web search engines providing access to abundant text and multimedia data that greatly supports learners' exploratory searches (Marchionini, 2006) needed to tackle a problem.

Easy access to the diversity of online resources allows learners multiple ways to verify their linguistic knowledge and thus encourages them to monitor their language use such as the scenarios of self or other-correction. According to Littlewood (1996), being able to use appropriate learning strategies to facilitate one's learning is considered an important characteristic of learner autonomy. Thus, learners' strategic use of online resources to accommodate their own learning needs has a role in contributing to the development of learner autonomy. In addition, Kessler and Bikowski (2010) indicate that learners' ability to contribute personal meanings in collaboration is one of the aspects fostering autonomy in collaborative learners. In the present study, online resources may also show their value in promoting learner autonomy by facilitating learners' contributions in discussion. Teachers can make this autonomous learning space explicit for learners to raise their awareness of learning responsibility and to enhance their learning experiences in Internet-mediated contexts. The pedagogical implications and future research suggestions are discussed in the conclusion section.

## Conclusion

The scope of CSCL is concerned not only with online interactions among collaborating learners, but also with the role technology plays in face-to-face interactions among learners. This study contributes to this area by exploring the dynamics of interactions and scaffolding among peers collaborating face-to-face and online resources in a bespoke language learning setting. Through the lens of collective scaffolding, the participants in the study were observed to interact with their peers and the online resources in three distinctive patterns whereby they co-constructed knowledge, created shared understandings, and achieved HQC. These patterns are (1) peer-to-peer scaffolding, which reinforced peer assistance, (2) multi-directional scaffolding, which facilitated the co-construction of shared understanding, and (3) individual scaffolding, a product of interaction with online resources, which helped improve language accuracy. These three types of scaffolding have been shown to be critical in supporting the participants' language discussions and meaning-making processes.

Given that the three types of scaffolding respectively reinforce peer assistance, facilitate the co-construction of shard understanding, and improve language accuracy, they can be seen as fostering autonomous learning among collaborating language learners. Learners thus can be encouraged to involve online resources in their discussions and engage with the scaffolding online resources provide to accommodate their specific needs in language learning. Teachers can also encourage less proficient peers to use online resources to encourage their contributions to language discussions in collaborative tasks. Higher proficient peers can also be encouraged to take advantage of diverse online resource to help their lower proficient counterpart with language difficulties. A prerequisite of effective use of online resources, however, is the acquisition of new literacy skills necessary in the information age, which include the ability to locate information from multiple sources, critically evaluate information, synthesize information, and effectively communicate information to others (Coiro, Knobel, Lankshear, & Leu, 2008). Among them, being able to search for multimodal information from multiple sources is highlighted by Pegrum (2011) as an essential ability in the digital age to make the utmost use of online resources. To maximize the beneficial effects of online resources and foster the dynamics of scaffold-ing, formal instruction of these new literacy skills can be given before learners embark on their collaborative technology-enhanced tasks. As Lai, Yeung, and Hu (2015) note, teachers' demonstration of using technological resources to enhance language learning, the introduction of strategies in technol-ogy use, and the recommendation of useful resources can promote learners' self-directed use of technological resources for language learning in various contexts.

The findings portray the complex interactions among collaborating ESL learners and accessible online resources in the meaning-making process. It also sheds light on the potential pedagogical value of online resources in collaborative face-to-face language learning settings. However, the current study has several limitations that should be acknowledged. First, this study was situated in a specific setting, a face-to-face collaborative writing with the support of online resources in a language learning context, so the findings may not be directly generalizable to other contexts. Another limitation is that the small scale of the study with a small number of participants may lead to a relatively limited observation of learner interactions with peers and online resources in collaborative writing. Future studies could expand the scale of the study with a larger group of participants, possibly from different education levels, so that a pattern of interaction in different levels could be observed. In addition, a longitudinal research design will help the researcher gain more insight into shifts and changes in learner interactions over time. Future studies can also delve into the resources collaborating learners utilize when carrying out different types of activities and how various resources may impact their interactive patterns and knowledge construction.

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